MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER.

DECEMBER 9, 1896.

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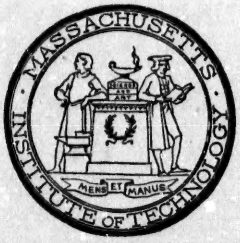

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To the Corporation of the Massachusetts Institute of Technology:

The year upon which I am to report has been, in general, one of prosperity. The number of students has more than held its own, in spite of the hard times. Unusually large additions have been made to the plant of the Electrical and the Mechanical Engineering Departments. While the need of room has been felt more than ever before, this has been largely due to the development of the courses, the increase of machinery and apparatus, and the ever increasing specialization of the work of the higher years. It has not been loss but gain which has caused the degree of inconvenience and discomfort which has been experienced. This is the kind of hardship which it is easiest to put up with. At the same time, it must be said that it will not be possible for the school to continue long in the cramped condition into which it has been brought by its remarkable growth, without the beginnings of serious injury.

In the spring of the present year, it was for a time hoped that, in spite of the limited means at the disposal of the Corporation, a new building might afford relief to several overburdened departments, and provide for the growth of the school during a few years to come. So strongly did the Executive Committee entertain this belief that plans were prepared for a structure which should extend southward from the Architectural Building toward the Providence Railroad about one hundred and fifty feet, with a width of fifty-eight feet, and which should comprise four stories[1] and a basement, yielding an aggregate available floor space, after deduction of stairs and hallways, of about thirty-seven thousand square

[1] Since the Engineering and Architectural Buildings were erected, a change in the building laws of the city has reduced the number of stories which can be obtained in a structure of this type.

feet. Professors Chandler and Homer, and other members of the instructing staff of the Architectural Department, undertook, in a very public-spirited way, to make the plans which were carried into every detail of construction upon a scale and in a manner which would allow the work to be immediately proceeded with. Unfortunately, the Executive Committee received legal advice that it was doubtful whether a certain amount of money which was to come to the Institute by bequest would be available for such a use. This unexpected complication arrested the efforts the Executive Committee were putting forth to get the matter into such a shape that they could bring it before the Corporation. An attempt was made to secure the funds by subscription; but the general condition of business and the feeling of those to whom the school would naturally turn for relief and assistance were such as to give no encouragement. The matter was accordingly dropped for the time. It will be the cause of deep regret if the friends of the school do not, at an early date, enable this hopeful project to be carried out.

Perhaps I cannot better show what are the present most pressing needs of the school than by briefly indicating the uses to which it was proposed to devote the new building. The departments which were especially to be benefited were Chemistry, Architecture, Biology, Mechanical Engineering, and Naval Architecture. In the basement, in addition to the heating and ventilating apparatus, was to be a large and well-equipped lecture room for General Chemistry. The room (No. 35) devoted to this purpose in the Walker Building has long been inadequate. Its seating capacity (200) has been so small as to require the lectures to the first year classes to be repeated. Again, this room is not high enough to allow the most effective seating of the students, with a view to enable each one to watch the professor's hand during experimentation. The new lecture room was to be large enough (52 × 52 ft.) to allow the whole class to be assembled at once, and high enough (17 ft. in the clear) to allow the best results in seating the students. To afford an unobstructed

view in this room, there were to be no central columns; and the weight of the four stories above was to be carried by a large steel girder, leaving a clear view of the professor's table. In addition to this large lecture room, the basement was to contain, besides the staircase and entrance hall, a modelling room (26 × 54 ft.) for the Architectural Department; a lecture room of the same dimensions; Professor Pope's office; a dressing room and elevator. A passage way was also provided for the use of teams carrying coal to the boiler-house in the rear.

The first floor, which was to be reached both by the present stairway of the Architectural Building and by a large staircase located at the centre of the new building, was to contain the Department of Biology. The need of increased space for this important and growing branch of the Institute has been set forth in several annual reports of the President. The technical applications of Biology have within recent years become of great industrial and commercial importance. This school has from the first taken the lead in instruction and in investigation in these lines; and it will be a matter of the deepest regret if Professor Sedgwick and his capable staff are not soon afforded an opportunity to carry on their work with every facility and advantage, instead of, as now, under conditions which not only restrict the scope of their work, but inevitably impair its quality. The plans for the biological laboratory, as worked out in conjunction by Professor Sedgwick and Professor Chandler, were ingenious and effective.

The portions of the second and third floors nearest the present Architectural Building, and connecting with its present rooms by the existing staircase and landings, were to be devoted to the enlargement of the Architectural Department. The effect of this change would be to bring all the architectural drawing-rooms upon two floors, instead of distributing them up and down throughout the whole height of a building, as at the present time. Each of the three upper classes of the department would thus be given a large drawing-room,

no student being separated from the library by more than one flight of stairs. The third floor of the present building would be devoted entirely to the library. This latter arrangement would not only provide for the future increase of the collections of books and photographs, but would permit a freedom in their use which is impossible under the present cramped conditions. Our architectural library is now a magnificent one; but the space afforded is not sufficient to allow the students to make the most of it, and on account of this lack of proper space the professors of the department cannot introduce some desired changes in the courses requiring the study of books and photographs. In addition to the provision thus to be made for ample drawing-rooms and for a largely increased use of the library, a feature of great importance was to be added. It is very necessary that opportunity be given for the study of full-size casts of classic architecture. To attain this end, a room, of the whole depth of the building and forty feet in length, was to be assigned to our museum of architectural appliances, models and designs; while, in order to get the proper effect of height, in placing the plaster casts of columns, friezes, and full-size ornaments, this room was to rise through the next story to the roof, the floor of the fourth story being left out through the entire width of the building and for a length of twenty-eight feet. In this way it would be possible to give the proper effect to the superb casts now coming into the possession of the department through the expenditure of the income of the Arthur Rotch fund. Of the portions of the third and fourth stories not occupied by the Architectural Department, it was proposed to reserve a part for certain important uses, such as a small gymnasium for the young women of the Institute, lecture, recitation rooms, etc., while another part was to be left vacant to allow of future expansion.

The fourth and uppermost story of the new building — with the exception of the space, twenty-eight feet by the depth of the building, cut out for the benefit of the Architectural museum, as before stated — was to be devoted to the

laboratory of General Chemistry. During the thirteen years since that laboratory was placed on the fourth floor of the Walker Building, our classes have increased to a degree which renders the accommodations provided scarcely adequate. In spite, however, of considerable inconvenience resulting from lack of room, the staff of the chemical department would still prefer to leave the laboratory of general chemistry in the Walker Building, were it not that the other branches of the department are in urgent need of additional accommodation, which the withdrawal of the laboratory and the lecture room of general chemistry would allow to be supplied.

Such was to be the new building of the Institute of Technology according to the plans of the Executive Committee, carefully wrought out in conference with the professors of the several departments, and put into definite form by the unwearying zeal of Professors Chandler and Homer, and their assistants. But it would not be possible to give an adequate idea of the advantages which would result to the school from this source without speaking of the uses it was proposed to make of the space that would be vacated in the existing buildings. The Architectural Department being concentrated upon two floors of the two buildings, the basement and the fourth floor of the present building would be vacated. In the basement it was proposed to afford opportunity for the expansion of Professor Lanza's superb laboratory of Applied Mechanics, now doing a work in the testing of materials and in engineering experimentation, which, it is believed, is nowhere paralleled. The fourth floor it was proposed to devote either entirely to the department of Naval Architecture, or jointly to the departments of Naval Architecture and Civil Engineering. The need of separate provision for the drawing-work of the former department, now carried on in the drawing-room of the mechanical engineers, and for the accumulation and proper disposition of models, blue prints, and other material, has been set forth in successive reports of the President. That need is constantly in-

creasing; and must soon be met if this useful and promising branch of our work is to have an adequate development. The first floor of the present Architectural building is devoted to recitation and lecture rooms; and these it was not proposed to disturb. The fifth and uppermost floor, which is at present devoted to life class-work, and to freehand and water-color drawing, it was proposed to continue in its present use.

Turning now to the Walker Building, let us inquire what could have been done there for the expansion of the Departments of Chemistry and Physics, at present occupying the whole of that building except the few rooms reserved for instruction in modern languages and mathematics. The withdrawal of general chemistry would have left the laboratory (90 × 40 ft.) on the Newbury Street side of the fourth story to be occupied by the laboratories of analytical chemistry and organic chemistry, each of which has outgrown its existing quarters; while the present lecture room of general chemistry would become available for uses which the Executive Committee did not deem it important to determine in advance. The needs of the two departments are so great that even the apportionment of this space would still leave much to be desired. This should not, however, make us indifferent to the measure of relief which would be afforded.

Turning now to the Rogers Building, I ask the attention of the Corporation to the great advantage, both scholarly, social, and sanitary, which the withdrawal of the Biological Department would afford. The laboratory now occupied by that department extends ninety feet across the whole width of the building on its Newbury Street end, and is thirty feet in depth; this it was proposed to make a general reading-room for the students of the Institute, with the Librarian's office at one end. Such a reading-room, especially if reached by new staircases at the rear of the building, above the present entrance into the basement, and warmed and lighted during the evening, for study or for quiet conversation, would constitute

an addition of inexpressible value to the present accommodations for our students. To many, the opportunity for passing their evenings in a large, well-lighted, well-furnished and well-ventilated room would not only facilitate their progress as scholars, but would afford a very valuable means of bringing them into better social relations than they now enjoy at the Institute. Such a room would also, upon occasion, be used for gatherings of students or for receptions by the President and members of the Faculty, and would constitute an important addition to our resources on commencement and other gala days. The present library would naturally become a much needed Faculty room.

Such was the pleasant dream in which the Executive Committee and the Faculty indulged themselves until rudely awakened by the impossibility of securing the necessary funds under the painful industrial and commercial conditions prevailing the past season. Is it too much to hope that those who have again and again come forward to the support of the Institute in its times of need and trial, will not long allow the school to suffer from accommodations so painfully cramped? I have here upon the table the plans which I have referred to as prepared by the Executive Committee last spring. It may interest the members of the Corporation to examine them; and any information which may be desired regarding the uses of the several portions of the building will be cheerfully given. I would say, in closing, that the Executive Committee received propositions from responsible builders which would have brought the entire cost of the building to about a hundred thousand dollars.

When it was at last reluctantly admitted that it was impossible to undertake the construction of a building which should be available for any part of the present school year, it became absolutely necessary to make a certain degree of provision for the Chemical Department. The situation was this: every desk in the laboratory of organic chemistry was occupied, while the in-coming fourth-year class was to be considerably larger. Many of the needs of the Institute were

urgent and pressing; but this seemed the most imperative. In consequence, all the changes made were to meet this single exigency. The William Ripley Nichols Chemical Library, which has for thirteen years been on the fourth floor of the Walker Building, was removed to Rooms 39 A and B, on the third floor. Here, the space formerly occupied by Dr. Drown for his private study and laboratory, and a part of the space occupied heretofore for molecular-weight determinations, was fitted up for a library. Not only are the present collections agreeably and conveniently placed here, with an effective installation of electric lights; but the additional room will provide for their normal increase through some years to come. A portion of the former room 39 A has been retained as a laboratory of molecular-weight determinations.

The space thus made vacant on the fourth floor has been utilized, through the removal of some partitions and the erection of others, for enlarging the laboratory of organic chemistry by the addition of eight students' desks, with convenient hoods and other fittings. The remainder has been divided into two laboratories, a small one for an instructor's use, and a larger one which will be occupied by Professor Noyes for organic and physical-chemical research.

The Graduating Class.

The school year of 1895–96 closed on the 9th of June, according to the new calendar of which I spoke in my last report. The graduating exercises will hereafter come always in June, the introduction of several holidays having the effect to bring commencement between the 3d and 11th of that month. The class of 1896 was the largest in the history of the school, numbering 188. Of these 25 graduated in Civil Engineering, 34 in Mechanical Engineering, 10 in Mining Engineering, 24 in Architecture, 16 in Chemistry, 48 in Electrical Engineering, 3 in Physics, 3 in Biology, 7 in Chemical Engineering, 4 in Sanitary Engineering, 3 in Geology, 5 in Naval Architecture, while 7 graduated from the

Department of General Studies. Of the Bachelors of 1895, three — Messrs. Frank Augustus Bourne, Herbert William Chamberlain, and George Defren — received the degree of Master of Science, on the completion of an additional year of successful study, the first two in Architecture, the last in Chemistry.

The Entering Class.

The registration of this year, as by the Catalogue now in press, amounts to 1,198 against 1,187 twelve months ago. It appears, therefore, that in the number of students this year the school has held its own.

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1881–82	302
1866–67	137	1882–83	368
1867–68	167	1883–84	443
1868–69	172	1884–85	579
1869–70	206	1885–86	609
1870–71	224	1886–87	637
1871–72	261	1887–88	720
1872–73	348	1888–89	827
1873–74	276	1889–90	909
1874–75	248	1890–91	937
1875–76	255	1891–92	1,011
1876–77	215	1892–93	1,060
1877–78	194	1893–94	1,157
1878–79	188	1894–95	1,183
1879–80	203	1895–96	1,187
1880–81	253	1896–97	1,198

Students by Classes.

The aggregate number of students for 1896–97 is divided among the several classes as follows: —

Graduate students, candidates for advanced degrees	11
Regular students, Fourth Year	194
" " Third "	198
" " Second "	182
" " First "	286
Special students	327
Total	1,198

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Graduates of the M. I. T.	11		11
Fourth Year	194	64	258
Third Year	198	92	290
Second Year	182	125	307
First Year	286	46	332
Total	871	327	1,198

Statistics of Examinations.

Of the 1,198 students of the present year, 440 were not connected with the school in 1895–96. Of these, 263 were admitted as regular students of the first year upon the basis of their entrance examinations. The 177 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 263 who were thus admitted to the Institute on examination, and have taken their place in the school, 66 were admitted on examination, but have not entered the school. The number of this last class, always large, has this year been increased even over that of last year by the continued depression in busines

In the case of the 263 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	183
" on one condition	43
" on two conditions	23
" on more than two conditions	14
	263

Thirty-nine applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in June and September, examinations were conducted in June at Albany, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Easthampton (Mass.), Exeter (N. H.), Lawrenceville (N. J.), Los Angeles, Louisville, New York, Philadelphia, Pittsburgh, Portland (Maine), Portland (Oregon), Pottstown (Pa.), St. Paul, Seattle, Washington.

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	1	1	..	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	3	1	1	6	3	9
Colorado	..	..	1	3	..	4	3	7
Connecticut	..	6	5	2	5	11	6	24
Delaware	..	1	..	1	1	3	2	5
Dist. of Columbia	..	..	3	2	6	11	6	17
Georgia	..	..	..	1	1	2	1	3
Idaho	..	..	..	1	..	1	..	1
Illinois	..	12	2	6	12	32	13	45
Indiana	..	..	..	1	1	2	1	3
Iowa	..	1	..	4	1	6	8	14
Kansas	..	..	1	..	..	2	1	3
Kentucky	..	3	1	3	2	10	2	12
Maine	..	3	4	5	8	20	7	27
Maryland	..	1	2	2	3	9	..	9
Massachusetts	11	119	130	106	179	545	185	730
Michigan	..	1	2	2	1	6	..	6
Minnesota	..	3	..	1	..	4	3	7
Missouri	..	1	..	2	4	7	4	11
Montana	..	..	..	..	1	1	2	3
Nebraska	..	..	1	..	..	1	1	2
New Hampshire	..	3	6	3	6	18	8	26
New Jersey	..	1	3	3	3	10	3	13
New York	..	12	13	7	15	47	22	69
North Carolina	..	..	..	..	1	1	..	1
Ohio	..	6	6	3	5	20	8	28
Oregon	..	..	..	1	2	3	1	4
Pennsylvania	..	7	4	6	12	29	13	42
Rhode Island	..	6	2	4	3	15	5	20
South Carolina	..	1	..	..	3	4	2	6
Tennessee	..	..	1	..	..	1	..	1
Texas	..	..	1	..	1	2	..	2
Utah	..	..	..	1	..	1	1	2
Vermont	..	1	..	2	2	5	2	7
Virginia	..	..	2	1	..	3	..	3
Washington	..	..	..	..	2	2	3	5
West Virginia	..	..	..	..	1	1	1	2
Wisconsin	..	..	1	1	1	3	3	6
Wyoming	..	..	..	..	..	..	1	1
Foreign Countries.								
Chile	..	..	..	..	..	..	1	1
Cuba	..	..	..	1	..	1	1	2
England	..	..	..	1	..	2	..	2
France	..	..	..	..	1	1	..	1
Japan	..	1	1	..	..	2	..	2
Mexico	..	..	..	1	..	1	2	3
New Brunswick	..	..	..	2	..	2	..	2
Nova Scotia	..	1	..	..	..	1	..	1
Ontario	..	2	..	..	..	2	..	2
Quebec	..	..	1	..	..	1	1	2
Turkey	..	..	..	1	..	1	..	1
Venezuela	..	..	..	..	..	..	1	1
Total	11	194	198	182	286	871	327	1198

Thirty-nine States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,198, 730 are from Massachusetts, or 60.9 per cent. of the whole; 104 are from other New England States; 364 are from outside New England. Of these, 20 are from foreign countries.

A table showing the number of students in each year, from 1890, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:—

	1890.	1891.	1892.	1893.	1894.	1895.	1896.
States.							
Alabama	..	2	4	2	1	..	1
Arkansas	3	3	2	1	..	..	1
California	14	10	14	15	9	8	9
Colorado	4	7	7	5	8	7	7
Connecticut	31	30	27	30	29	27	24
Delaware	1	..	2	4	3	5	5
Dist. of Columbia	7	4	4	7	12	10	17
Florida	3	3	4	3	2	1	..
Georgia	2	2	3	3	2	2	3
Idaho	..	1	1	1	..	1	1
Illinois	34	32	40	39	36	42	45
Indiana	6	3	5	6	3	2	3
Iowa	9	10	10	13	10	12	14
Kansas	2	2	1	1	4	4	3
Kentucky	4	8	7	11	12	11	12
Louisiana	8	5	2	3	3	2	..
Maine	29	27	39	36	38	38	27
Maryland	7	7	6	4	4	9	9
Massachusetts	517	565	603	665	707	721	730
Michigan	16	13	10	7	8	7	6
Minnesota	12	13	13	11	9	5	7
Missouri	8	12	13	17	14	9	11
Montana	1	..	..	2	2	1	3
Nebraska	1	1	4	3	4	2	2
Nevada	4	3	3	2	2	..	..
New Hampshire	23	24	20	32	27	30	26
New Jersey	11	16	11	6	5	5	13
New Mexico	..	1	2	2	1	1	..
New York	40	40	50	52	59	64	69
North Carolina	1	1	1	..	..	..	1
Ohio	33	33	39	45	50	37	28
Oregon	1	1	2	1	1	1	4
Pennsylvania	22	26	25	31	37	36	42
Rhode Island	21	26	24	33	25	21	20
South Carolina	2	4	1	3	3	5	6
South Dakota	..	..	..	..	..	..	..
Tennessee	3	4	1	1	1	1	1
Texas	1	2	5	6	6	3	2
Utah	..	..	1	2	2	5	2
Vermont	4	5	4	5	3	5	7
Virginia	5	6	4	3	2	5	3
Washington	2	3	3	1	3	1	5
West Virginia	2	2	2	1	1	3	2
Wisconsin	10	7	9	11	6	7	6
Wyoming	..	..	..	..	..	..	1
Foreign Countries.							
Argentine Rep.	2	..	..	..	..	..	..
Belgium	..	..	1	1	1	..	..
Brazil	2	4	..	..	3	1	..
Bulgaria	1	1	1	1	..	..	..
Central America	..	1	1	1	..	1	..
Chile	..	..	..	..	1	1	1
Colombia	..	2	..	..	..	..	..
Cuba	..	..	..	1	1	3	2
England	2	1	1	1	..	2	2
France	1	1	1	1	..	..	1
Germany	..	..	..	2	1	..	..
Guatemala	..	..	1	..	..	..	..
Hawaiian Islands	4	4	2	2	..	..	..
Holland	..	2	2	2	2	..	..
Ireland	1	..	..	1	1	..	..
Japan	4	3	1	1	1	2	2
Mexico	1	1	1	1	1	1	3
New Brunswick	1	2	1	1	1	1	2
New South Wales	..	1	1	1	1	1	..
Nova Scotia	2	1	..	..	1	2	1
Ontario	1	2	2	4	4	2	2
Peru	3	1	..	..	..	..	..
Porto R	2	1	..	1	1	1	..
Quebec	4	4	5	5	2	2	2
Scotland	3	2	1	2	1	..	..
Spain	..	..	1	1	1	1	..
Trinidad	1	1	..	..	..	..	..
Turkey	1	2	1	..	1	3	1
Venezuela	..	1	..	1	1	1	1
Total	937	1011	1060	1157	1183	1187	1198

Residence of Massachusetts Students.

It has been said that 60.9 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-two cities and towns are borne on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Suffolk sends two hundred and thirty-five, and Middlesex two hundred and twenty-five pupils; Essex comes third, with seventy-nine; Norfolk, fourth, with sixty-seven.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	5	7	Hampshire	2	2
Berkshire	0	13	Middlesex	32	225
Bristol	6	33	Nantucket	1	1
Dukes	1	1	Norfolk	15	67
Essex	21	79	Plymouth	12	29
Franklin	2	2	Suffolk	3	235
Hampden	4	10	Worcester	12	26
			Total	122	730

The following is a list of the towns, forty-two in number, which send four or more students to the Institute: —

Boston	228	Waltham	9	Lawrence	5
Newton	44	Reading	8	Natick	5
Cambridge	30	Taunton	8	Springfield	5
Brookline	21	Gloucester	7	Wakefield	5
Newburyport	20	Melrose	7	Watertown	5
Somerville	19	Worcester	7	Wellesley	5
Malden	16	Chelsea	6	Woburn	5
Hyde Park	14	Concord	6	Essex	4
New Bedford	12	Framingham	6	Mansfield	4
Lowell	11	Weston	6	Milton	4
Brockton	10	Arlington	5	Pittsfield	4
Lynn	10	Belmont	5	Plymouth	4
Salem	10	Fall River	5	Randolph	4
Medford	9	Fitchburg	5	Winchester	4

The following table exhibits for ten years the distribution of the total number of students among two classes: first,

those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular first-year Students.	(5) No. of New Students not of the regular first-year class.
1887–88	720	396	324	229	95
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out those who are repeating the first year, and eleven persons of unusual ages. These deductions

Period of Life.	1895–6.		1896–7.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years . . .	5	—	2	—
16½ to 17 " . . .	4	9	3	5
17 to 17½ " . . .	28	—	19	—
17½ to 18 " . . .	23	51	40	59
18 to 18½ " . . .	38	—	52	—
18½ to 19 " . . .	49	87	44	96
19 to 19½ " . . .	42	—	41	—
19½ to 20 " . . .	23	65	28	69
20 to 20½ " . . .	19	—	23	—
20½ to 21 " . . .	16	35	9	32
21 to 22 " . . .	11	11	11	11
	258	258	272	272

leave two hundred and seventy-two as the number of students whose ages have been made the subject of computation. The results appear in the table above in comparison with the corresponding results of 1895–96.

From the foregoing, it appears that the average age on entrance is eighteen years and eleven months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and eighty-eight members of the class were distributed among the different periods of life as follows: —

Between	20	and	20½	2
"	20½	"	21	7
"	21	"	21½	11
"	21½	"	22	18
"	22	"	23	51
"	23	"	24	48
"	24 and over			51
Total				188

The special students this year constitute twenty-seven per cent of the whole body, as against twenty-eight per cent last year, and twenty-nine per cent the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is eighty. Of these, eleven are our own graduates, candidates for advanced degrees; sixty-nine are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Fourteen are graduates of Harvard University; five of Amherst College; four of Yale University; three each of Brown University, Georgetown University, Smith College, and Wellesley College; two each of Iowa State College, Johns Hopkins University, and Princeton University; while the following institutions are represented on our list by a single graduate each: Universities of California, Chicago, Michigan, Minnesota, Rochester, Santiago, Vermont; Cornell, Drake, Indianapolis,

and Norwich Universities; Boston, Carleton, Central Turkey, Colorado, Dartmouth, Dickinson, Hampden-Sidney, Middlebury, St. Johns, Trinity, Tufts, Williams Colleges; Colegio de Carreras; Throop Institute; U. S. Artillery School; and Virginia Polytechnic Institute.

The graduates of the Institute who are candidates for advanced degrees are Messrs. Charles William Berry, of the class of '95, the holder of the Swett Fellowship, in Physics, George Vincent Wendell, of the class of '92, the holder of the Savage Fellowship, in Physics, both studying abroad; Miss Margaret Eliot Dodd, of the class of '92, Mr. Simeon Curtis Keith, Jr., of the class of '93, Mr. George Linder Bixby, of the class of '95, Messrs. Henry Cummings, Jr., Ralph Coolidge Henry, Herbert Edwards Smith, Albert Ernest Smyser, James Smith Smyser, William Henry Whitten, Jr., all of the class of '96. Of the seventy-one graduate students not candidates for advanced degrees thirty-two are regular students, — viz., twelve in the fourth year, thirteen in the third year, six in the second year, one in the first year. Of the thirty-one graduates who are regular students in the three upper classes, one takes both Mechanical and Electrical Engineering; one takes both Mechanical and Chemical Engineering; eight take Civil Engineering; two, Mechanical Engineering; one, Mining Engineering; five, Architecture; one, Chemistry; eleven, Electrical Engineering; and one, Chemical Engineering.

Women as Students at the Institute.

The number of women pursuing courses with us is seventy-one. Of these, eight are graduates of colleges. Of the total number, one is a candidate for an advanced degree; two are regular students of the fourth year; four, of the third year; five, of the second year; five, of the first year. Fifty-four are special students. Of the eleven regular students of the upper classes, four take Course IV., Architecture; three, Course V., Chemistry; two, Course VII., Biology; two, Course VIII., Physics. Of the special students, thirty-four devote them-

selves to Biology, eight to Chemistry, six to Architecture, two to General Studies, one to Physics, one to Geology, one to Mathematics, and one to Drawing.

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class	29	41	7	18	22	40	2	4	7	13	4	..	8	194*
3d " "	31	46	8	28	22	34	2	5	4	7	3	..	9	198*
2d " "	39	36	9	19	22	32	3	2	..	14	1	..	8	182*
Total . .	99	123	24	65	66	106	7	11	11	34	8	0	25	574*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1886 . . .	45	75	19	13	24	52	4	2	8	..	..	..	..	242
1887 . . .	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888 . . .	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889 . . .	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892 . . .	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893 . . .	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895 . . .	88	118	25	67	59	126	7	11	14	25	10	2	22	575
1896 . . .	99	117	24	65	66	106	7	11	11	34	8	..	25	573

* Deducting those counted twice.

The following table exhibits the number of persons who have graduated within each of the several courses at each succeeding year since the first diplomas were conferred:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	.	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	6	6	1	1	..	..	..	1	2	..	..	..	..	27
1876	12	9	7	..	5	1	..	2	3	4	..	..	..	..	43
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	32	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
Total	319	366	145	109	176	1	286	29	23	60	49	17	7	10	1,594
Deduct names counted twice															10
Net total															1,584

* Deducting names counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves

as electing to distribute the required studies and exercises over the period of five years.

Year.	Total	Courses.											
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	3	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	10	4	1	..	1	1	2	..	..	..	..	..	..	1
3d . .	11	2	4	1	1	1	..	..	1	..	..	..	..	1
4th . .	12	..	2	..	1	..	7	..	1	..	..	..	..	1
5th . .	6	..	..	1	..	1	1	..	1	1	..	..	..	1
	42	6	7	2	3	3	10	..	3	1	..	..	..	4

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing each particular branch of study: —

Applied Mechanics . . .	65	History	78
Architecture	55	Language	161
Biology	51	Mathematics	162
Chemistry	127	Mechanical Engineering .	79
Civil Engineering . . .	39	Mining Engineering . .	11
Drawing	157	Physics	145
Electrical Engineering . .	30	Political Science	69
English	104	Shopwork	75
Geology	27		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . . .	336	237	131	64	768
Chemistry	382	81	67	63	593
English	306	256	12	13	587
French	192	75	57	7	331
Physics	..	265	236	170	671
German	73	197	151	3	424
Shopwork	19	115	67	72	273

The most noticeable feature of the foregoing tables is the large falling-off in the number of students taking mathematics, especially in the third and fourth years. Last year the total number of students in this department was 881; this year it is only 768. Last year the number of students of the third and fourth years together taking mathematics was 285; this year it is only 195. The chief reason for this is found in the increased requirements in mathematics, at entrance. I ought to add that, while there has thus been a reduction in the total number of students taking mathematics, owing to the increase in entrance requirements, the number of students taking advanced mathematics has steadily advanced during the few years; and still further progress may be anticipated. In the other departments named, the number of students holds its own, as in the case of the modern languages, or shows an increase, as in the case of chemistry, physics, or shop-work.

Changes in the Faculty and the Corps of Instruction.

The year has fortunately passed without the loss of any member of the Faculty from any cause. Professor Holman's health most unfortunately remains such as wholly to incapacitate him for work with his classes. The affliction which has been so heroically borne by this ripe scholar and gifted teacher is a source of sorrow to all his associates in the Faculty and in the corps of instruction, as it must be to all his former pupils and his many friends. Even infirmity and confinement have not sufficed to fetter his masterly hand; and the last two years of sickness and pain have witnessed the preparation of several important professional treatises.

Within the Faculty several promotions have been made. The following associate professors have been raised to the rank of full professors, namely: Peter Schwamb, S.B., to be Professor of Mechanism and Director of the Workshops; C. Frank Allen, S.B., to be Professor of Railroad Engineer-

ing; Alfred E. Burton, S.B., to be Professor of Topographical Engineering; Dwight Porter, Ph.B., to be Professor of Hydraulic Engineering. Assistant Professor Linus Faunce, S.B., has been promoted to Associate Professor of Drawing. The Faculty has been reinforced by the following promotions from the corps of instructors, namely: George H. Barton, S.B., to be Assistant Professor of Geology; William H. Lawrence, S.B., to be Assistant Professor of Architecture; Arthur G. Robbins, S.B., to be Assistant Professor of Highway Engineering; Joseph J. Skinner, Ph.D., to be Assistant Professor of Mathematics.

The following is the academic and professional history of the several members of the Faculty who have received promotions during the year and of the new instructors appointed:

Professor Allen was graduated from the Institute in 1872 in Civil Engineering. For five years he was engaged in the active practice of his profession, on the Water Works and Sewerage of Providence, R. I., the Water Works of Newton, and the Sewerage of Boston. He then went west, and for ten years was occupied in various capacities on the Atchison, Topeka and Santa Fé Railway in Kansas, Colorado, and New Mexico, and was for a time in the employ of the Mexican Central Railway. He also engaged in some private practice during this period, and was for a time Chief Engineer of the Las Vegas (N. Mex.) Water Works. In 1887 he returned to Boston to accept the position of Assistant Professor of Railroad Engineering at the Institute, and in 1889 was made Associate Professor. Professor Allen is a member of the American Society of Civil Engineers, a Director of the Massachusetts Highway Association, and Secretary of the Society for the Promotion of Engineering Education, besides being a member of other scientific bodies.

Professor Peter Schwamb was graduated in 1878 from the Institute of Technology in the department of Mechanical Engineering. In 1879 he was draughtsman for the Howe Scale Co., Rutland, Vt.; from 1880 to 1883, draughtsman for the Hinck-

ley Locomotive Co., Boston. In 1883 he became Instructor in Mechanical Engineering in the Institute of Technology; from 1884 to 1888 he was Assistant Professor of Mechanism; in 1888 he was appointed Associate Professor of Mechanism. He has been Director of the Workshops since 1883.

Professor Burton was graduated from the Civil Engineering Department of Bowdoin College in 1878, and for a year or more thereafter practised as a land surveyor in Maine. In 1879 he entered the service of the Coast Survey, where he remained for three years, first as topographical draughtsman, and then as topographer. In 1882 he accepted the position of Instructor in Civil Engineering at the Institute. In 1884 he was made Assistant Professor, and in 1889 Associate Professor of Topographical Engineering. Professor Burton was in 1895 appointed by Governor Greenhalge a member of the Massachusetts Topographical Survey Commission, a position which he still holds.

Professor Porter was graduated from the Sheffield Scientific School of Yale University in 1880, and at once entered the service of the government as an expert in the water power investigation of the Tenth Census. He was engaged upon this work for four years, and published numerous reports on the Hydrography and Water Power of various portions of the country. He came to the Institute in 1883, and served for a short time as Instructor in Mathematics, but later became Instructor in Civil Engineering. In 1887 he was appointed Assistant Professor of Hydraulic and Sanitary Engineering, and in 1890 Associate Professor. Professor Porter has delivered lectures on sanitary subjects at the Pratt Institute of Brooklyn and at the School of Sociology at Hartford, and, in addition to his work at the Institute, has been consulted as an expert in a great variety of matters relating to Hydraulic and Sanitary Engineering, among which may be mentioned the investigation of the sanitary condition of tenement houses in Boston, which he undertook in 1886, and the question of damming the Charles River, which came up so prominently last year. Professor Porter is a member of the American

Society of Civil Engineers, as well as of various other technical associations.

Professor Faunce, a graduate of the Institute in 1877, and subsequently engaged in the engineering department of the New York & New England Railroad, was appointed Assistant Professor of Drawing in 1884, and placed in charge of the drawing of the first-year, and of the second-year Descriptive Geometry.

Professor Robbins was graduated from the Institute in 1886, and has since that time been engaged continuously in teaching, first as Assistant, and then as Instructor in Civil Engineering. For several years past he has had charge, under the general direction of Professor Allen, of the instruction in Highway Engineering.

Professor Barton was graduated in the department of Mining Engineering and Geology in 1880. After spending a year as Assistant in Drawing, he went to the Hawaiian Islands as Assistant on the Government Survey, where he remained two years. He was then called to return to the Institute as Assistant in Geology, and, while occupying this position, devoted his time to work in Mineralogy, Structural Geology, and Blowpipe Analysis. In 1886 he was appointed Instructor in Determinative Mineralogy; in 1892 Instructor in Geology. He has given the instruction in the Blowpipe Laboratory and in Micro-Lithology, and has taught Structural Geology to the students in the department of Civil Engineering. For nine years he has given lecture-room and field instruction in Mineralogy or Geology to large classes in the "Teachers' School of Science" of the Boston Society of Natural History. He has also extended his studies of geologic phenomena by travel, and by his original investigations when employed by the United States Geological Survey. During the past summer he was a member of the party which made a special study of the glaciers and other features of the Umanak district in Greenland.

Professor Lawrence was graduated from the Institute in 1891, and was at once made Instructor in Architecture. His

active interest, the accuracy of his work, and his ability as a teacher have been highly appreciated.

Dr. Skinner, a graduate of the Sheffield Scientific School of New Haven, was appointed Instructor in Mathematics in 1885.

While no vacancy has occurred in the Faculty of the Institute, the corps of instructors has lost one of its oldest members, — Mr. James Hugh Stanwood, for eight years Assistant or Instructor in Civil Engineering, who died May 24th last, after a lingering illness. Mr. Stanwood was born in 1860 in Brunswick, Maine, and after receiving his earlier education in the public schools of Portland, entered in 1879 the office of Edward C. Jordan, at Portland, where he was engaged for over a year. He was afterwards in the office of the City Engineer of Portland, in the employ of the Maine Central Railroad and in other engineering work. He entered the Institute in 1883, and graduated four years later, having worked during the summer vacations with the Maine Central Railroad. Immediately after graduating, he entered the office of the Philadelphia Bridge Works, where he remained for over a year as Assistant to the Designing Engineer. In 1888 he returned to the Institute, where he has since remained. Mr. Stanwood was extremely faithful in the discharge of his duties, and his associates and former students remember him with affection and respect.

Mr. Henry Nash Dickinson, who has been Instructor in English at the Institute from 1891 to 1896, has resigned to engage in secondary teaching at Norfolk, Conn. Mr. Edward Robinson, of the class of '91, formerly Instructor in Mechanical Drawing and Descriptive Geometry, has accepted an appointment for similar work at the new Clarkson School of Technology, Potsdam, N. Y. Mr. Simeon C. Keith, Jr., of the class of '93, is now occupied with various commercial interests connected with Bacteriology, but is continuing his studies as a candidate for the Master's degree. Mr. Joseph P. Lyon, Instructor in Civil Engineering, has resigned during the year, to enter professional practice. Mr. Henry E.

Crampton, Instructor in Biology, has also terminated his connection with the Institute, receiving an appointment as University Fellow at Columbia University.

The following gentlemen, Assistants of last year in the several departments named, have been appointed Instructors: George B. Haven, S.B., '94, and Alexander W. Moseley, S.B., '91, in Mechanical Engineering; Frank P. McKibben, S.B., '94, in Civil Engineering; James F. Norris, Ph.D., in Organic Chemistry; Joseph W. Phelan, S.B., '94, in General Chemistry; Samuel C. Prescott, S.B., '94, in Biology. William J. Drisko, S.B., '95, in Physics; Arthur W. Weysse, Harvard A.B., '91, A.M., '92, Ph.D., '94, has been appointed Instructor in Biology. He studied in 1894-95 at the Universities of Leipsic and Berlin; in 1895–96 at Paris and in the Zoölogical Station at Naples. He has been Assistant in Zoölogy at Radcliffe and in Botany at Harvard, and has published several papers on zoölogical subjects.

The following named Assistants have been appointed for the current year: Reuben E. Bakenhus, S.B., '96, Minor S. Jameson, S.B., '96, Charles M. Spofford, S.B., '93, and Harold C. Stevens, S.B., '96, in Civil Engineering; Amadeus W. Grabau, S.B., '96, in Geology; Leonard H. Goodhue, S.B., '96, in Analytical Chemistry; Harrison W. Hayward, S.B., '96, in Industrial Chemistry; Albert J. Wells, S.B., '96, in Mechanical Drawing; Edward M. Bragg, S.B., '96, and Frank B. Masters, S.B., '95, in Mechanical Engineering; William L. Root, S.B., '96, in Oil and Gas Analysis; George K. Burgess, S.B., '96, William D. Coolidge, S.B., '96, and Ralph R. Lawrence, S.B., '95, in Physics; Clarence W. Perley, S.B., '96, in Biology.

Statistics of the Corps of Instructors.

The Catalogue of 1896–97 shows the number of instructors of all grades to be one hundred and twenty-seven, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addi-

tion of these raises the total to one hundred and fifty-three. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1895–96	1896–97
Professors	19	23
Associate Professors	10	7
Assistant Professors	18	21
Instructors	53	52
Assistants	21	24
Lecturers	26	26
Total	147	153

The Library.

The accessions during the year were 4,433, which may be classified as follows: —

By purchase	1,647
" binding	580
" gift	2,206
Total	4,433

After deducting from the above the number of books, pamphlets, etc., reported lost, worn out, or removed from the shelves for other causes, the net accessions during the year are found to amount to 4,411. The following table shows the net accessions of books, pamphlets, and maps to each of the libraries of the Institute, together with the cost of those purchased by the departments. The table also shows the total number of volumes, and of pamphlets and maps taken together, in each library, September 30, 1896. To a certain extent the pamphlets are counted twice, for, according to the custom established in previous reports, a collection of pamphlets bound together in one volume is counted as one in the enumeration of the volumes, while at the same time each pamphlet in the volume is counted as one in the list of pamphlets.

TABLE SHOWING THE NET ACCESSIONS FOR THE YEAR 1895–96, WITH THE COST OF THE SAME AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE ON SEPTEMBER 30, 1896.

LIBRARIES.	Vols. added.	Pamph. added.	Maps added.	Cost (Dept.)	Total Vols.	Total Pamph. and Maps.
General	422	277		$ 340.44	4,654	3,112
Engineering	621	90	329	1,023.53	6,671	3,121
Mining	168	28		180.38	1,686	303
Architectural	232	10		294.61	1,879	181
Chemical	336	51		450.66	6,565	1,437
Biological	134	20		201.38	1,802	351
Physical	587	24		643.24	5,385	656
Economics and History	616	132	6	619.45	7,973	2,975
English	170			160.42	2,184	36
Geological	94	20	37	103.90	1,667	761
Margaret Cheney Room	7				575	13
Totals	3,387	652	372	$4,018.01	41,041	12,946

The above table shows that at the end of the academic year there was a total of 41,041 volumes in the libraries, and that there were also 12,946 pamphlets and maps, making a grand total of 53,947.

During the year there were 1,178 orders sent out for the purchase of books. Ninety orders were returned to heads of departments as duplicates; of these five were reordered; 1122 volumes were bound; 412 stamped on the back with the shelf number and the initials of the Institute. The total cost of binding was $1,263.42. To the main catalogue 2,561 cards have been added, and a slightly larger number, in the aggregate, to the catalogues of the departmental libraries. The total number of cards now in the main catalogue is 37,432.

Two hundred and thirty-nine books were received for inspection, of which ninety-nine were purchased. It has not been possible to keep a record of the number of books borrowed, except in the Chemical Library, and from this one there were taken out for use at home more than 1,030 books during the nine months from January 1st to September 30th.

The Institute has been so fortunate as to receive during the year gifts amounting to 2,206 books, pamphlets, and maps. Among the most noteworthy of these may be mentioned, — thirteen volumes by bequest from the estate of the late Sig. R. Urbino, including Brehm's Thierleben, six volumes; a complete set of the Encyclopedie-Roret, 143 volumes, from Mr. George L. Roberts; from the U. S. Coast and Geodetic Survey, 252 charts, completing our set; 119 volumes of architectural books from Mrs. Henry Draper, including Van Ysendyck, Documents Classés de l'Art dans les Pays-Bas, five volumes; Histoire de l'Art pendant la Renaissance en Italie, three volumes; Dieulafoy, L'Art Antique de la Perse, five volumes; Havard, La France Artistique et Monumentale six volumes; Gotch, Architecture of the Renaissance in England, two volumes; the first twelve volumes of the Architectural Association Sketch-book; and Van Stegmann and Geymüller, Die Architektur der Renaissance in Toscana, a beautiful work, of which thirty-six parts have been issued.

The assistants in charge of the Chemical and Physical Libraries have been instructed during the year by the Librarian in the art of cataloguing books; and they now write all the catalogue cards for their respective libraries. This plan was found to be so successful and to increase so much the general efficiency of the library service, that it is being extended to the Engineering Library. The Librarian is still obliged, however, to write the catalogue cards for the other eight libraries of the Institute, besides doing an immense amount of other purely clerical and more or less mechanical work, from which it is desirable that he should be relieved as soon as arrangements to that end can be made.

Advanced Degrees.

During the past year, a measure which it is believed will have important scholarly results has been adopted by the Faculty after long and careful consideration. The situation out of which the new procedure arose may be illustrated as follows: A young man has graduated from the Institute, let us say, in Mechanical Engineering. His scholarly ambitions and his financial means concur to induce him to remain for an additional year of study. Should his plans embrace systematic, advanced work in the course from which he has graduated, as would be likely to be the case with a graduate in Chemistry or in Architecture, for example, he would naturally become a candidate for the degree of Master of Science. But it has been found in our experience that the larger proportion of the not large number of students thus able and desirous to pursue additional studies at the Institute, prefer to take the work belonging to some other course more or less closely allied to that from which they graduated. For example, a student having finished the Mechanical or Chemical Engineering course is likely to choose work in Electrical Engineering, to constitute at least the greater part of his additional year's work. Under the former rules of the Faculty, he might, at the end of a year of successful study, receive, not the Master's degree, but the Bachelor's degree in his new department. By the new rule it is rendered possible for a graduate in one department, subject to conditions established for the purpose of guarding the scholarly character of the higher degree, to obtain, not a second Bachelor's degree, but the degree of Master, while pursuing work mainly in another department from that in which he graduated. There is still required, however, in general a certain amount of strictly advanced work; while the thesis presented is expected to be of a higher order than would be exacted in the case of a first degree.

The consideration which chiefly moved the Faculty to make this important modification of the pre-existing require-

ments for the Master's degree was that a student who had successfully completed any one of the thorough courses of study at the Institute, and had taken his Bachelor's degree, would, as a matter of course, take up and carry on the fourth year's undergraduate work of another department in a stronger and more masterly way than would have been possible but for his previous training and preparation, and his maturer age. In other words, though the subjects studied in the additional year are to a considerable degree under-graduate studies to the men of that course, they become, in a certain and high sense, graduate studies to the graduate student, by reason of his superior age and qualifications. Certainly, no one can question that a man who has taken an additional year of study and has handsomely completed two courses at the Institute is a riper scholar and a better equipped professional man than if he had only completed a single course. Why, then, should he not receive an acknowledgment of this addition to his scholarly character and standing?

While for the foregoing reasons the requirements for the Master's degree are made more liberal than heretofore, the conditions imposed are, it is believed, such as will protect the degree against any tendencies to a real lowering of the standard. I am happy to be able to add that the more liberal provisions governing this matter have already resulted in a considerable increase in the number of applications for the Master's degree.

Double Degrees.

Another matter of much scholarly interest which has been dealt with by the Faculty during the past year, has been the question of students receiving the Bachelor's degree in two departments at the same time. This has been done, and the degrees conferred accordingly. But, while the Faculty are not disposed to take the position that in some cases this may not be done to the advantage of the student, they yet feel that there is danger of abuse arising from this source.

Since it is naturally regarded as a feather in a man's cap to take two degrees at once, there will always be some ground to fear that a student may attempt this, not for the sake of a larger knowledge and a broader culture, but for the distinction attending it, with the result either that he may fail in both courses, or, what is more probable, that he will get through all the studies and exercises of both courses, but without doing any part of the work very well. It does not need to be said that it is far better for a young man to take one course in a masterly way than to take two in a somewhat halting fashion, even though the actual requirements for the degree be met. At the same time, the Faculty are aware that cases occur where a student can do two courses at once and do them thoroughly; and even that the two may mutually support and supplement each other.

Under the foregoing circumstances, it seemed to the Faculty desirable to take the matter up for systematic regulation. The amendment of the Faculty rules which has been adopted is the result of much consideration given to this subject, and will, it is believed, prevent students from undertaking a double course unless the reasons therefor shall, in their individual cases, be strong and clear. The rule now reads as follows:—

"An applicant for the degree of Bachelor of Science in two courses at the same time must have made application for such candidacy not later than November 1st, next preceding his graduation. Such application shall be referred to a special committee of the Faculty to report as to the eligibility of the candidate, and, in case his application is approved, to have the oversight of all of his work for the remainder of the year, and to report to the Faculty, at the close of each term, as to the character of the work done. The committee shall decide as to the time and manner of carrying on the thesis-work required, and may in special cases recommend that the candidate be allowed to conduct the two theses at the same time."

Scholarships.

The scholarship resources of the Institute have been considerably enlarged. It will be remembered that the grant, in 1895, of $25,000 per year, for six years, by the General Court of Massachusetts, was accompanied by a special appropriation for ten free scholarships for six years, supplementing the twenty scholarships established by the Act of 1887. The demand for these scholarships had been so great that, without any initiative on the part of the Institute, an act was passed at the session of 1896, establishing forty permanent State scholarships, in place of the arrangement, in part permanent and in part temporary, stated above. Every senatorial district in the State is now permanently entitled to representation in the Institute; and it is hoped that the few districts which at present send no applicants may avail themselves of the benefits of this provision of the Commonwealth. By the will of Mrs. Ann White Vose, the Institute has received for the aid of needy and deserving students a sum amounting to about $50,000. Scholarship awards for the present year have amounted to nearly $14,000; and still it has hardly been possible to provide even for the urgent cases.

By the generosity and kindly interest of Mr. Charles H. Dalton, long a member and once Treasurer of the Institute of Technology, a fund of $5,000 has been established for the endowment of a graduate scholarship in Chemistry, the income to be used for the payment of fees of American male students, graduates of the Institute, who may wish to pursue advanced chemical study and research, especially applicable to textile industries.

In memory of the late William Hall Kerr, of the class of 1883, his widow, formerly, as Miss Alice M. Getchell, a special student at the Institute, has established a fund of $2,000, the income to be applied to the maintenance of a special library of machine design.

The Technology Club.

While the matter is not one which officially comes within the cognizance of the Corporation, I know the members will be glad to learn, if they have not been previously advised, of the formation of a social club, to be known as The Technology Club, constituted of such members of the Corporation, the Faculty and the corps of instructors, and of such past students of the Institute as may desire to join, together with a certain number of students elected from the several classes, and especially from the upper classes. The organization of the club was due to a feeling, long entertained, that opportunities for social intercourse, and for conference regarding matters of interest to the school, should, in some way, be provided. After full discussion the enterprise was launched last spring; Mr. James P. Munroe, long the Secretary of the Institute, was elected President; the house No. 71 Newbury St., directly opposite the vacant space between the Rogers Building and the Natural History Building, was rented for a term of years and fitted up simply but pleasantly for social uses. At the beginning of the present school year, the Club was opened, and has now been in full operation for nearly three months, apparently with the highest success, notwithstanding the fact that the fees are exceptionally low. Those who have charge of its fortunes have shown as much prudence as energy. They are thoroughly devoted to the interests of the Institute; and they are bent on making the Club a force for good in the development of the school.

Official Advisers.

In a previous report, I referred to the system of advisers to new students which had been adopted by the Faculty, not with any view to appointing guardians for the young men, or to taking any degree of responsibility whatever for their conduct and deportment, but simply as a means of introducing each student coming for the first time to the school to some

member of the Faculty or instructing staff who would hold himself under obligation to afford such information and advice as might be asked. As was stated in my former reference to this subject, it was not expected or desired that this system should amount to a very great deal. It could not do this without interfering with that responsibility for their own lives, that accountability as ordinary citizens of the community, which has been a fundamental principle in the government of the Institute. But it was believed when this step was taken that the appointment of official advisers, for the limited objects in view, would be useful and helpful to many new students, and that this advantage would be increased as the advisers assigned to the duty should have larger experience in dealing with young men in this way. These expectations have been justified by the result. There have been no drawbacks to the operation of this system, and its whole effect has been for good. It is believed that the influence upon the students of the school has been not inconsiderable.

The Y. M. C. Association.

I am happy to say that still further efforts are being made for the purpose of assisting the student, on newly coming to the Institute, to order his life in Boston to the best advantage; and, also, to improve the general social character of the school. The Young Men's Christian Association of the Institute has especially directed its energies to the first mentioned object. The Association issues a small manual, containing much information useful to the new-comer. It has recently, for the second time, held its annual reception for new students, whether of the first-year class or not, an occasion of much interest and doubtless of real practical influence for good. The present year the Association has made the important advance of taking an ordinary dwelling-house at the South End and making it a club-house, most of the rooms being occupied by the officers and other members of the Association, as their ordinary living-rooms, while the

public rooms are freely open to students. This certainly shows a most commendable spirit on the part of the young men concerned, who have as good an opportunity as they could possibly desire to exert an excellent influence upon the social life of the school. I do not see why several such centres of benevolent activity may not in time be established in different parts of the city where our students most congregate. One additional direction of effort by the Young Men's Christian Association is specially worthy of notice. This is the attempt to secure pleasant and wholesome homes for newcomers. The officers and the committees of the Association have taken a great deal of pains to secure information as to houses into which students may be introduced to the greatest advantage, and this information is freely communicated to all who care to avail themselves of it.

The Institute was represented at the annual meeting in Washington of the Association of American Agricultural Colleges and Experiment Stations by Professors Allen and Tyler. The principal matter affecting the interests of the Institute was the proposed establishment of Engineering Experiment Stations, corresponding to the Agricultural Experiment Stations established in 1887. The Faculty accepted the invitation of the College of New Jersey to send a delegate to the celebration of its one hundred and fiftieth anniversary, in October of the present year. The Institute was represented by the President on that very interesting occasion when the College of New Jersey became Princeton University.

Entrance Requirements.

Four years ago, the Catalogue contained the statement that the Faculty were considering the expediency of making a further advance in entrance requirements and that it was probable such a step would be taken at no distant date. This announcement was made for the purpose of giving the preparatory schools fair notice and enabling them to consider

the question with due deliberation. At the present time, the Faculty have the matter under active discussion; but no definite conclusion has been reached. Inasmuch as the question of entrance examinations is one which is at present undergoing very active agitation, and as the Institute of Technology has been somewhat misrepresented in the course of discussion, it seems to me desirable to state just what our position is upon this matter.

The arguments in favor of an advance in the entrance requirements are strong. It is unquestionable that we should do our work better if our students came to us with the amount of preparation contemplated, and that the high schools of the land ought to be so organized and officered that they could give this instruction without difficulty and without further delaying the preparation of their pupils for college. Just here, in the last point mentioned, lies the main difficulty and perplexity of the subject. Important as the Faculty of the Institute consider the additional preparation to be, they will be entirely unwilling to ask it, if, after much discussion and conference with the secondary schools, it shall appear that the effect of such increased requirements would be to increase appreciably the age of our students at entrance. That age, which is now about eighteen years and eight or nine months, is fully as high as is considered to be for the best scholarly development of the pupils. Such an average means that a large number enter at an age considerably greater.

Further to increase the average age on entrance, or further to procrastinate the entrance of men above the average age, would, in the opinion of the Faculty, be distinctly and highly objectionable. They believe that students should not be held back in the secondary schools after they have reached the degree of maturity necessary for taking our work, even if it be to give them still further high-school preparation. The average boy of nineteen years has outgrown the spirit of the secondary school. If compelled to stay longer, his mental growth is retarded or possibly encounters a permanent check. The pupil who is held back to finish his high-school course

until he is twenty. is probably not more but less fortunate than one who comes to us at eighteen, even with a somewhat less complete preparation. When a certain period has been reached, youth, with its pliability and adaptability, is of more value to a student of this school, at least, than a certain amount of additional knowledge and the mental training involved in the acquisition of that knowledge.

The question, therefore, whether the advance in entrance requirements at the Institute which has so long been under consideration shall soon be adopted, depends mainly upon the answer to the question whether the preparatory schools can so deal with the matter as to send us pupils, equally well trained and equipped in other respects, who shall bring with them the additional preparation required, at an age not appreciably greater than that of to-day. This is not on its face impossible. Better and higher results can often be reached without any greater strain and in no longer time, simply by a better arrangement and systematization of work; by omitting traditional topics which are of no real importance; and by reapportioning the time to be expended upon the different parts of a subject. To our inquiries many of the preparatory schools have returned cordial and encouraging answers. Their desire is to make the advance which has been suggested. On the other hand, it is necessary that we should proceed with great caution in the interest of less fortunate schools, which, with a smaller staff of teachers and fewer resources, have all they can do at present to meet our requirements. To demand of them more may mean either a mere cramming for our examination, which we should deprecate, or the introduction of an intermediate year at some academy or distant high school. This last would involve an expense which many students would not be able to bear, and would be, on many other accounts, far from desirable.

ENGLISH.

A new departure has been taken by the English Department in the matter of the teaching of composition. There

are students who have elsewhere covered the first-year requirements in rhetoric, or have even succeeded in passing the examinations at the Institute, yet who have serious faults in the mechanics of writing. To aid these men in overcoming their defects, and to insure that no graduate shall be unable to write clear and correct business English, the department has undertaken the special individual supervision of these students. The experiment is being tried of calling to account men who are noticeably unable to spell or to write with reasonable correctness, and of insisting that effort be made to correct these faults. In connection with this, the chemistry notebooks of first-year students are examined weekly by the English Department to secure their being written with care and accuracy. By the coöperation of the instructors of the Department of Architecture, arrangements have also been made [illegible] the papers of these students criticised for the English. It may be added that the increasing responsiveness of students to the work in literature is especially gratifying, and can hardly fail to lead to increased efficiency in all the work of the English Department. The work has been taken up with very great zeal by Professor Bates and his accomplished assistants. The amount of labor which they have brought upon themselves has been very great; and I trust that the financial condition of the school will soon permit of a reinforcement of the staff in English, so that every student of the Institute may receive no inconsiderable amount of individual attention from the instructors in this department.

Mathematics. — Still further changes in the arrangement of the work of the Mathematical Department have resulted from the advance in entrance requirements, which took effect in 1894, and which has now enabled the class of '98 to complete integral calculus during its second year. The time thus set free in the first term of the third year has been used in part for differential equations. Students in Electrical Engineering now complete this subject in the first term of the third year, instead of in the final term of their course, as heretofore.

The students in Mechanical Engineering, Chemical Engineering, and Naval Architecture take a brief course in differential equations, of particular value for their subsequent work in mechanics. An elective course was given last year by Dr. Woods on the theory of functions, and has been succeeded this year by a course on the theory of surfaces, open to advanced students and members of the instructing staff. The resources of the department have been much enlarged by the purchase of models. The collection is now ample for our own needs, and is of great value for certain branches of advanced work. Professors Woods and Bailey have in preparation a text-book on analytic geometry which will be used by the first-year class during the second term.

Modern Languages. — The work of the Modern Language Department has been carried on by Professor van Daell and his associates during the past year successfully, but without any notable change, yet with that degree of progress which comes from continuous attention and experience. In one direction, however, the modern language work of the Institute shows a very gratifying gain. I shall, in the following pages, call attention to several instances where important departments of the school are giving their students of the upper classes considerable practice in the reading of journals and scientific papers in French and German. This has always been done as far as the time and strength of the instructing staff would allow; but the later developments of the school have allowed it to be carried on during the past two or three years to a much larger extent. Nothing could be more desirable, and I trust to be able to report further progress another year.

Military Science and Tactics. — The instruction in Military Science, both theoretical and practical, has been carried on most fortunately during the year, under the able and judicious direction of Captain Bigelow. The recent improvement in this service has been truly remarkable. The spirit of the department has steadily risen, the instruction has constantly

become more scientific, while the practical results, as seen in the armory drill, are better than ever before. In truth, Captain Bigelow's two years of service here have made a distinct contribution to the subject of military instruction in colleges, by demonstrating that, even with a closely limited amount of time devoted to a course, sound, substantial results, worthy to be compared with the best results of instruction in mathematics, in philosophy or natural science, in history or the classics, can be obtained through the full utilization of the resources available, and a judicious and energetic direction of the work. The number of students of the first year regularly belonging to the battalion is exactly three hundred. In addition to these, four students receive the theoretical instruction in Military Science without the drill, having been excused from the latter on examination. One student is taking the drill as an option, making the total number of students in the department three hundred and five. In the examination held for candidates for appointment to the grade of officer in the battalion, twenty schools were represented, and two organizations of the National Guard, one in Illinois and one in New Jersey. The total number of students offering themselves for examination was thirty-five. All but one or two were new students at the Institute.

History and Political Science. — In History, a constantly increasing use is made of specially prepared maps, charts, diagrams, etc., in all the courses. This is true to a very large extent in the subjects taken by all the students of the first and second years. To the preparation of such material Professor Currier and Mr. Sumner have given a great deal of attention; and the resources of the department have been very greatly increased thereby. Maps, charts, and diagrams of appropriate sizes are now available for the illustration of every subject covered in the several courses; and these are so placed in cases, constructed especially for the purpose, that they are readily available for use.

By every means, the instructors in this department are

striving to make the work in history more and more fruitful. It has long been one of the highly approved features of the Massachusetts Institute of Technology that its courses combine some measure of philosophical studies with the predominant scientific and technical exercises of the school. In this matter, the Institute has been a leader among the scientific and technical schools of our country; and this feature is one which, while it cannot be greatly extended in the time given to it, may yet be truly magnified through the improvement and enlargement of the courses thus given. I have great satisfaction in feeling that our work in history is being done in the most admirable spirit and with a high degree of intelligence. A very interesting suggestion has been made that it might be found possible to establish relations between this department of the Institute of Technology and the teachers of history in the schools of Boston and vicinity through which the latter might be enabled, by no undue effort or sacrifice of time, to pursue courses of study here, not merely in history but in the related subjects of economics, statistics, sociology, and government. That the teaching of history in our grammar and high schools greatly needs enrichment and inspiration will be readily admitted by all. Whether the Institute could in any important degree contribute to this branch of instruction, is a matter to which thought will be given in the immediate future.

The work in Political Economy for all the students of the third year is being better systematized by the publication of a weekly syllabus; there is, moreover, a constantly increasing oversight of the written work of the students as carried on throughout the term.

Shopwork. — As it is some years since I have made more than a passing allusion to our shops, it seems appropriate to state just where we stand in this matter at the present time. No great changes have taken place; but under the enlightened direction of Professor Schwamb there has been a steady movement towards larger and better work. The members of the Corporation are aware that our shops have, from the first,

been of the character of laboratories. The exercises taking place in them are intended to be as purely and as highly educational as those in the laboratory of chemistry or physics. In each of the shop courses the student completes, from working drawings, a systematic series of "pieces," or models, designed to cover progressively the principles to be taught and to give practice in the use of the different tools or machines. So far as practicable, the models are useful objects; but in no case is the prime, I may even say, the sole object of the course, namely, instruction, sacrificed or subordinated to considerations of immediate utility. Our shops are not factories, but laboratories. It is not the thing made, but the training, the discipline, the practice, which the student obtains in the making, which forms the object in view.

Seven shop courses are recognized upon our schedules, namely, carpentry and wood-turning, pattern-work, foundry-work, forging, chipping and filing, metal-turning, machine-tool work. Of these, the course in foundry-work is purely optional, not being required as an essential part of any course. It is, however, taken by a considerable class. The course in metal-turning is specially arranged for students in electrical and chemical engineering. The instruction is in light lathe-work, on iron and on brass.

The equipment of the several departments of the shops is as follows: The carpentry, wood-turning, and pattern-making departments contain forty carpenters' benches, two circular-saw benches, a swing-saw, two jig-saws, a buzz-planer, a mortising machine, thirty-six wood-lathes, a large pattern-maker's lathe, and thirty-six pattern-makers' benches. The foundry contains a cupola furnace, two brass furnaces, a core oven, and thirty-two moulders' benches. The forge-shop contains thirty-two forges, seven blacksmiths' vises, and one blacksmith's hand-drill. The machine-shop contains twenty-three engine-lathes, seventeen hand-lathes fitted with slide-rests, two machine-drills, three planers, a shaping-machine, two universal milling-machines, furnished with spiral and gear-cutting attachments, a universal grinding-machine, a cutter

and reamer-grinder, a twenty-four-inch standard measuring-machine, thirty-two vise-benches arranged for instruction in bench-work, and a fully equipped tool-room. A power-hammer will be added to the equipment of the forge-shop during this year.

The number of students who can be accommodated at a time in each class is as follows: carpentry, forty; wood-turning and pattern-making, thirty-six; foundry-work, thirty-two; forging and chipping and filing, thirty-two; machine-tool work, twenty-three when all students are upon lathe-work, thirty when their work can be varied.

The following table gives the total number of hours allotted to the different shopwork subjects: —

Subject.	Mechan. Eng.	Elect. Eng.	Physics	Chemical Eng.	Naval Architect	Special Class.
Carpentry and Wood Turning	60	60	60	60	..	135
Pattern Work	30	..	..	..	..	90
Foundry Work	30	..	..	..	..	45
Forging	110	..	..	45	110	135
Chipping and Filing	70	..	..	..	70	60
Metal Turning	...	30	..	30	..	..
Machine-Tool Work	150	..	..	..	120	120

The following table shows the number of students taking the different shopwork courses during the past three years, with the corresponding numbers for 1896–97 estimated on the basis of the first term's registration: —

Subject.	1893–94.	1894–95.	1895–96.	1896–97.
Carpentry and Wood Turning	138	133	124	138
Pattern Work	55	72	68	90
Foundry Work	28	36	38	40
Forging	85	66	78	110
Chipping and Filing	58	54	60	69
Metal Turning	96	59	61	66
Machine-Tool Work	49	52	48	59

Students taking chipping and filing are only counted in the third year's part of the course.

In addition to the foregoing, there is a special class comprising five professional teachers taking the course in pattern-work.

Summer Schools.

Mining. — The Summer School of Mining was held this year among the iron mines of Michigan, Wisconsin, and Minnesota. Visits to mines and to furnaces occur on alternate years. This was the year for the mines. The party consisted of Professors Richards and Hofman and ten students. The students were from the second, third, and fourth-year classes of the Mining Department. Through the generosity of Messrs. M. A. Hanna & Co., of Cleveland, the members of the party were transported upon the ore-boats of the Company from Ashtabula, Ohio, to Escanaba, Michigan, one of the ports of the iron mines, and back again. The work of inspection and study began at Ironwood, in the Gogebic district, with the great Norrie mine, after which followed the Aurora, the Tilden, and the Newport mines. The party next visited, in the Mesabi Range, the Mountain Iron mine, the Oliver, the Norman, and the Franklin mines. On the return by way of Duluth, the great ore docks were inspected. Finally the Chapin, the Pewabic, and the Aragon mines of the Menominee Range were visited. The students found a great deal of interest in these remarkable iron districts, not only in the geology of the deposits, which has been a great puzzle to the geologists, but in the mining methods which have been brought to their present state of perfection by close competition and by the use of the highest engineering skill. The students and professors met with the kindest reception everywhere.

Geodesy, Topography, and Hydraulic Engineering. — The Summer School for field work in Geodesy, Topography and Hydraulics, was held during the month of June at Machias, Maine, a new locality for this work. The instruction was in

charge of Professors Burton, Porter, and Robbins, assisted by Mr. H. K. Barrows, Assistant in Civil Engineering, and Mr. G. C. Whipple, a graduate from this department, and one of the inventors of the thermophone, referred to in my last report. Fourteen members of the third-year class were in attendance. A base-line was measured with the one hundred-meter tape, using the thermophone for the determination of the precise temperature of the tape. This work was similar to that of last summer, and the results were equally satisfactory. A system of triangulation was extended over the country in the vicinity of Machias, and connected with the triangulation points of the United States Coast Survey. A topographical survey of about two square miles was made with the plane table, on a scale of 1 to 5,000, with contours ten feet apart. Plane table surveys were also made of the river front, on scales of 1 to 1,000 and 1 to 10,000, with special reference to a study of the water-power. A feature of field instruction, which was introduced for the first time this year, was the study of tidal phenomena and the determination of a datum plane for elevations. Machias furnishes an excellent opportunity for the study of the tides, the range being over fifteen feet. A special form of tide gauge was devised by Professor Robbins for the work, and the plotted results prove the excellence of the design. The hydraulic work consisted in measurements of the flow of the Machias River, by floats and by meters, at a point a short distance above the village of Machias. The stream at this place is about one hundred and forty feet wide, and from twelve to fourteen feet deep. The flow through one of the mill flumes was also measured, using the current meters and the Darcy tube. The School was in every respect satisfactory and profitable. It will probably be carried on at the same place next year.

Architecture. — During the past year the department of Architecture has made an important extension of its work, taking the initiative by sending a group of its students abroad for the study of European architecture. Since 1893, when the first summer school was held at Chicago, the

serious study of the Colonial buildings of New England has given the classes opportunities for an intimate acquaintance with the peculiarities of our local architecture. The work thus conducted has been valuable; but it could not be expected to afford the student the broad knowledge of style which forms so important a part of thorough architectural training. The scheme of a tour in Europe was at once supported by the students with enthusiasm. Although a fee was necessarily charged, twenty students from the third and fourth years applied for admission. Applications from several students of other colleges had to be refused, in order to keep the school down to a practicable size. The class of twenty students, in charge of Professor Homer, who had as assistant Mr. F. M. Mann, S.M., '94, spent fifty days in England and France, touring on bicycles from London to Southampton, and through Normandy and Touraine to Paris. It was found that this way of travelling was particularly advantageous, as it did away with railway expenses, was entirely healthful, and afforded unusual opportunities for the study of local architecture. The large size of the class required careful preliminary arrangements. Maps were imported, routes decided upon, and hotel accommodations secured, before the expedition left America. General permission to photograph and draw was also obtained from the French government. The only difficulties encountered were those that arose from accidents to bicycles, and the temporary fatigue produced by the method of travelling, but nothing of a serious nature occurred at any time. The tour proved entirely successful, the eleven days in England and the thirty-nine days in France giving excellent opportunities for comparing examples of monumental and domestic architecture of the Romanesque, Gothic, and Renaissance styles of these countries. Pencil sketches and studies were made in each town visited, and a large number of photographs taken with the twelve cameras carried by instructors and students. The average necessary expense for the entire trip of seventy-six days proved to be $340.00. Omitting London and Paris, the

average necessary expense was $2.00 per day for England, and $1.90 for France. It is to be hoped that this successful precedent in the study of European architecture will be followed with good results in succeeding years.

Geology. — No summer school in Geology was held the past year, but during the semi-annual vacation the students in economic geology, under the guidance of Professor Crosby, made a ten days' excursion to Washington and the mining districts of eastern Pennsylvania. In Washington, attention was given chiefly to the important economic collections in the National Museum. The other points where special studies were made included the anthracite coal mines at Drifton, Pa., the slate quarries at Slatington, and the zinc and steel works at Bethlehem. Very profitable visits were also made to the Delaware Water Gap and the Cavern of Luray.

Summer Courses at the Institute.

The system of Summer Courses on which I have commented in the last two annual reports, has again been carried on in certain subjects, after the completion of the school year. The courses have generally lasted for five or six weeks, covering about the ground of the regular instruction of the year in the same subjects. A special committee of the Faculty under the chairmanship of Professor Crafts has had general charge of the arrangements. It has been previously remarked that only a considerable amount of experience in such a matter could enable us to decide whether this scheme would meet a real want. The experience of the last summer, in addition to that already acquired, seems to show that the courses offered have been, in number and variety, somewhat in excess of the needs of students, actual or prospective. At the same time, the attendance upon certain courses holds on well, and seems to indicate that these, at least, should be continued. The more successful courses of the present year were those in analytic geometry, analytical chemistry, organic analysis

and preparations, physical measurements, and machine-tool work.

Courses I. and XI., Civil and Sanitary Engineering. — No changes of importance have been made in the courses of study during the past year. During the coming year, 1897–98, some rearrangement of the work of the fourth year will be required, resulting from the transfer to the third year of the course in applied mechanics, hitherto given in the fourth year.

I have already spoken of the loss of the Civil Engineering Department through the death of Mr. Stanwood and the resignation of Mr. Lyon; Mr. H. K. Barrows, Assistant last year, also resigned to enter professional practice. The places thus left vacant have been filled, and one additional Assistant has been appointed, in view of the large increase in the work of the department.

In my last report, I referred to the desirability of our having a small building e d on firm ground in the neighboring country, equipped the necessary means for pendulum and magnetic observations and for the ordinary observations of field astronomy. The funds required for the erection of such a building having been granted by the Corporation, the building will be erected and partially equipped during the present year, as soon as a suitable site can be secured. Our facilities for instruction in the line of geodesy and practical astronomy will thereby be greatly improved, and it is hoped that the means for properly equipping this building will soon be forthcoming.

Mention should here be made of the fact that during the past summer Professor Burton, on the invitation of Lieutenant R. E. Peary, U. S. N., organized a party for scientific research in western Greenland. The party comprised Professors Burton and Barton, and Mr. R. W. Porter, from the Institute of Technology, Mr. G. R. Putnam, Assistant in the U. S. Coast and Geodetic Survey, and Messrs. J. C. Phillips and A. M. Dodge, students in Harvard University. Starting early in July, this party was taken in Lieutenant Peary's steamer

"Hope" to Umanak Fjord, Greenland, where it was left for five weeks, while Lieutenant Peary proceeded farther north, calling for the party on his return. The most important results of this expedition are the measurements of glacial motion and temperature and the study of glacial action, by Professors Burton and Barton, and the pendulum and magnetic measurements made by Mr. Putnam, who was specially detailed by the U. S. Coast and Geodetic Survey to accompany this expedition. The party was in every way successful, meeting with no mishaps, and the results will prove of value to science.

The equipment of the department has been increased in various ways during the past year. A collection of twenty-six levels and eight transits was purchased from the Mexican Central Railway Co., some of which will be disposed of, while the remainder, when put in good condition, will render it unnecessary for the department to purchase for the use of students any further instruments of this character for a long time to come. Two mercurial barometers have also been procured for use in the summer school. In the hydraulic laboratory a new measuring-tank has been procured, six feet in diameter and ten feet high, a duplicate of the one already in use, giving greatly increased facilities for the accurate measurement of considerable volumes of water in experimental work. The introduction of this tank required considerable changes in piping, chutes, and valves, for directing and controlling the flow of water. Valuable experiments were made last year, as a part of the thesis work of students, with apparatus specially planned for the purpose, in determining the effect of irreguiar connections and on the loss of head at sudden enlargements of pipes. For the convenient use of the present hydraulic apparatus, it is important that there should be an enlargement of the reservoir in the concrete floor, to which all water discharged in experiments is conducted, and from which it is pumped, being thus used repeatedly. It is also desirable that we should have increased pumping facilities, and arrangements have just been made for procuring a powerful rotary pump.

Mention should also be made of the fact that in the instruction of the Civil Engineering Department the use of lantern slides is being gradually introduced. During the past year over seven hundred slides were procured for use in various courses, principally relating to bridges and railroads. The only additional set of notes prepared by the instructors of this department during the past year is a new edition of Professor Porter's Notes on Stereotomy, for the use of the third-year students. Excursions have been made to several manufacturing establishments and other places of interest; and thanks are due to President Tuttle, of the Boston & Maine Railroad, W. H. Barnes, General Manager of the Boston & Albany Railroad, President C. P. Clark and General Superintendent E. G. Allen, of the New York, New Haven & Hartford Railroad, for courtesies extended to the classes. The department has also received during the past year a large number of blue-prints of various engineering works from city engineers, bridge companies, and other friends of the Institute.

In the present year there are forty students in the fourth year of the Courses in Civil and Sanitary Engineering; and the drawing-room is crowded to its utmost capacity. Four of these students are pursuing the Course in Sanitary Engineering and thirty-six that in Civil Engineering. Of the latter, twenty have elected the first, or general option, fifteen the second, or railroad option, and one, a special student, the third, or geodetic option.

Course II., Mechanical Engineering. — The following apparatus has been added to the laboratory, viz.: —

1. An Otto gas-engine of thirty-six horse-power capacity, with all the latest improvements.

2. An unusually complete and delicate apparatus for testing steam injectors, which was built and in service during the latter part of the last school year.

3. In place of the compound Marsh pump, of a capacity of eight hundred gallons per minute, which was loaned to the laboratory, and has now been returned to the makers,

a rotary pump has been added, of a capacity of one thousand gallons per minute, made by the Holyoke Machine Company.

4. A Buckeye steam-engine governor, arranged for experimental purposes.

5. A Rider hot-air engine has been presented to the laboratory by Mr. Fred A. Wilson, of the class of '91.

During the last school year, in the regular laboratory work, complete tests have been made of two large plants: one a fifty-hour test of the West End Street Railway Power Station at Sullivan Square, Charlestown, and one, another twenty-four-hour duty test of the triple engine of the Chestnut Hill Pumping Station.

The detailed results of the test of the latter plant made in May, 1895, by the students under the direction of Professor Miller, were published in No. IV. of the "Results of Tests made in the Engineering Laboratories," this being contained in the "Technology Quaterly" dated June–September, 1896. The results of other tests made in the Mechanical Engineering laboratory during the school year 1895–96, will appear in No. VI. of the "Results of Tests made in the Engineering Laboratories," contained in the "Technology Quarterly" for December, 1896.

There is great need of additional space, both in the laboratory and in the other rooms of the department.

This year, for the first time, the changes due to the increased requirements of admission affect the third-year class, and advantage has been taken of that fact to make a number of improvements in the course. Those which affect the third year, and which, therefore, take effect this year, are the following: —

1. A short course in elementary differential equations has been added.

2. A course has been added in industrial electricity and in electrical measurements.

3. Political economy is to be completed in the third year, instead of a portion being left for the fourth year, as heretofore.

4. A little additional time has been given to the third-year course in applied mechanics.

The following publications have been made by members of the department: —

1. A treatise on steam-boilers (now in press), by Professors Peabody and Miller.

2. A new edition of the "Notes on Dynamometers, Planimeters, Governors, and Fly-wheels," by Professor Lanza, has been printed.

It should also be noted that, during the last year, Professor Schwamb has been in charge of an extensive investigation of a matter of great public interest, on behalf of the Steam Users' Association.

APPLIED MECHANICS. — The following apparatus has been added to the laboratory; viz: —

1. An Olsen testing-machine, of one hundred thousand pounds' capacity, for tensile and compressive tests, capable of testing specimens five feet long and under.

2. A frame of two plate girders, together with a pair of large cast-iron skewbacks, previously in the laboratory, a set of steel rods, and other suitable apparatus, so far complete a machine of four hundred thousand pounds' capacity as to enable us, during the present school year, to make some tests of masonry arches of such sizes and proportions as are used in practice.

3. The machine for testing wire has been partly rebuilt, and very much improved.

In No. V. of the "Results of Tests made in the Engineering Laboratories," contained in the double number of the "Technology Quarterly" for June–September, 1896, are published the results of tests made in the course of the regular work of the laboratory, on the following subjects (the greater part having been made during the last school year): —

1. Tests of two series of bolted joints.

2. Tests of wrought-iron pipe of different sizes, used as columns; an investigation suggested by Mr. Hiram F. Mills of the Corporation, which we are still continuing.

3. Tests of spruce, and of Norway pine beams.

4. An extensive series of tests of the compressive strength of timber at right angles to the grain.

5. Torsional tests of shafting, mostly two inches in diameter.

6. Tests of the tensile strength of specimens of steel, and of iron wire, of manilla, of cotton, of hemp, and of sisal rope, and some tests of the strength of certain alloys.

7. Tests of the tensile and of the compressive strength of cement.

8. Torsional tests of wire, carried on in connection with tensile tests of the same wire.

Another investigation in which we are engaged in this laboratory, but of which no results have yet been published, is the strength, and behavior under load, of trusses built of 6-inch by 8-inch timber, with a variety of the framing joints commonly used in practice.

"Notes on Graphical Statics," by Professor Sondericker, has been printed for the use of the students.

A new and revised edition of the text-book on applied mechanics, by Professor Lanza, has been published.

Course III., Mining Engineering and Metallurgy. — The instructing staff of this department remains the same as last year. The largely increasing number of students rendered the ad[illegible]n of an Assistant highly desirable; but the Executive Committee found it possible to supply this want during a portion of the year only. A larger number of students are availing themselves of the advant[illegible]es of the department than ever before. The numbers now reach a total of forty-one, distributed as follows: twenty-one in the second year, twelve in the third year, eight in the fourth year.

During the past summer Professor Hofman made an extended tour, including Omaha, Kansas City, the Black Hills of Dakota, Denver, Pueblo, and Leadville, with a view to obtaining the latest data upon the me[illegible]lurgy of silver and lead. The results of his investigatio[illegible]ll be embodied in a new edition of his "Metallurgy of Lead," a book which has already

been everywhere accepted as authority. Professor Lodge took the opportunity of the meeting of the American Institute of Mining Engineers, held in Colorado last September, to visit Denver, Pueblo, Leadville, Aspen, Cripple Creek, and other places in the state, to bring his knowledge up to date in matters of sampling, assaying, milling, and smelting of gold, silver, copper, and lead ores. Professor Richards is now embodying the notes obtained in his extended trip through the principal mining regions during the summer of 1895, and also the results of his experiments and investigations made in the Mining Laboratory, in a book upon Ore Dressing, which he hopes to send to press some time next summer. He has spared no pains or expense in bringing the science and theory abreast of modern practice.

A circular has been prepared for the Mining Department, giving the course of instruction; suggestions to students taking the course; the details of the laboratories of mining engineering and metallurgy, together with a statement of the general plan and management. The pamphlet includes a list of theses illustrative of subjects investigated by students during the last term of their course, and finally gives a list of graduates and former students who have been directly or indirectly benefited by the department in their present occupations. This list gives a good idea of the influence this department is exercising upon the mining and metallurgical interests of the United States. Although there has been so much depression in business the past year, all the members of the graduating class have found occupation in the line of their profession.

A new course of lectures in general metallurgy and non-ferrous metallurgy has just been established for students in Chemistry and Chemical Engineering. Formerly the students in these courses attended a portion of the lectures given in the Mining Course. The lectures on electro-metallurgy for students in Electrical Engineering given last year as an experiment, have been adopted as a regular part of that course. The library of the department has grown

to the limit of the present book-shelves; but there is still room for more book-cases. Our collections of ores and products completely fill the present cases. The department will be unable to add to them until additional space shall be provided. Professor Richards has written "The Cycle of the Plunger Jig," a study of the theory of jigging ores for the separation of the waste minerals, also a second paper on "Sorting before Sizing," which discusses the whole theory of separation of the fine slimes. Professors Richards and Hofman have each contributed articles to "The Mining Industry," the former on "Progress in Ore Dressing in 1895;" the latter, on "Recent Improvements in the Treatment of Argentiferous Lead Ores." Professor Hofman has contributed two papers to the American Institute of Mining Engineers: "Further Experiments for Determining the Fusibility of Fire Clays," and "The Equipment of Mining and Metallurgical Laboratories." Professor Lodge has contributed two papers to the American Institute of Mining Engineers: "Treatment of a Roasted Gold Ore by Means of Bromine," and "The Cyanide Process as Applied to the Concentrates from a Nova Scotia Gold Ore."

The following periodicals have been added to the files of the Mining Department: The American Manufacturer; Annales des Mines de Belgique; Cassier's Magazine; Compressed Air; Digest of Physical Tests; Engineering Magazine; Jernkontorets Annaler; Journal of the Canadian Mining Institute; Mining Journal of the Northwestern Mining Association; The Foundry; Transactions of the Institution of Mining and Metallurgy, London.

Course IV., Architecture. — Not much requires to be said respecting the Architectural Department, which continues its steady gain, both in the number of pupils and in the character of the work done, from year to year. The collections of the department have been enlarged by a considerable number of superb architectural casts, although these very important accessories of architectural designing and drawing rooms cannot be placed to the best advantage in the existing build-

ing. Some noble architectural photographs, the gift of Mrs. Henry Draper, have been hung upon the walls. The library has been further increased by purchase, and still more largely by gifts. The library is now one of singular richness, and leaves almost nothing to be desired; but the space allotted to it is so narrow that the large illustrated volumes, photographs, etc., cannot be taken down and used upon the tables with anything like the freedom which is desirable.

An exceedingly important addition has been made to our working plant through the purchase, by Professor Homer, in Paris and London, the last summer, of twenty-six hundred lantern slides, containing views of buildings and cities in western Europe, Russia, and the East. These modern views will admirably supplement the present collection, and will materially assist the illustration of lectures. The views of Spanish, Russian, Indian, and Chinese architecture are particularly valuable, including a large amount of material at present available in no other form. The first instalment has already been received from London, and the remainder is expected at an early date. The new electric lantern of the Architectural Department makes the use of the slides much more convenient and effective. The interest taken by the students in the lectures has manifestly increased with the enlarged use of this mode of illustration. Two prizes, each the income of a fund of $5,000, which were established by the will of Mr. Arthur Rotch, for so long a time chairman of the Visiting Committee on the Architectural Department, became available for the year closing in June last. The prize for the student graduating with the greatest distinction from the regular course in Architecture was awarded to Miss Esther Stone, of Providence, R. I. The prize for the special student completing his course with the highest standing, was awarded to Mr. R. W. Porter, of Springfield, Vt., who is this year continuing advanced studies at the Institute. The Boston Society of Architects have also generously continued their two prizes, each of the value of $50 in books. These were awarded to Messrs. H. W. Chamberlain, of Hudson, Ohio,

and R. C. Henry, of Watertown, Mass. This year, again, in the competitions of the Beaux Arts Society of Architects of New York, the students of the Institute bore off the gold medal and the highest honors in each competition.

Courses V. and X., Chemistry and Chemical Engineering. — Professor Crafts, in a very public-spirited way, consented to continue, during the year on which I am reporting, that supervision and general direction from which the Chemical Department profited so much the previous year. The cares thus assumed by Professor Crafts were wholly in addition to his own proper work of instruction and research. We cannot be too grateful for this invaluable assistance, in our hour of need. Some changes have been made in order to secure more desk room, the fourth floor of the Walker Building is now occupied exclusively by the chemical laboratories, and the places are completely filled. Three hundred and seventy-one students take exercises in general chemistry; one hundred and thirteen students are in the analytical laboratory, and twenty-nine in the organic laboratory. The enlargements were made specially to meet the needs of an increased number of fourth-year students in Chemistry; and they have proved just sufficient for the purpose. It is thought they will also meet all the requirements that can be foreseen for the next two or three years.

The most important change has been the substitution of eight students' desks, and of two small private laboratory rooms for the Chemical Library. The library, which is one of the best in the world, was developed under the energetic direction of Professor Nichols, and each year adds to it every important work on chemistry and allied subjects. It has been of the greatest value to our own students; while the books on chemistry proper, and the rich collections of technical literature, are often consulted by workers outside of the Institute. For our own students the former situation of the library room, adjoining all the large laboratories, made it particularly convenient of access; and it was only after much hesitation transferred from the fourth to the third floor of the Walker

Building. We are pleased, however, to find that the change of place has diminished very little its usefulness to the students, while there is a distinct gain in larger accommodations and in a better ventilated space set apart for tables. In the portion of Room 39 which has been taken for the library the old cases with new additions will hold ten thousand volumes; and, when the time comes for further expansion, one-half more room can be added to the library by removing a temporary partition in Room 39, so that it may be considered that the Chemical Library has found its definitive home. Permanence of arrangement was also held in view in making the necessary additions to the organic chemical laboratory; and it is probable that the fourth floor of the Walker Building is now used to the best advantage; and that, if a new chemical laboratory is constructed, the present conveniences of plumbing, gas, and ventilation will continue to serve, with little change, for the analytical and organic chemical laboratories. At the time the Walker Building was constructed, it was an innovation to place laboratories in the highest story; but experience has shown that the best light and ventilation are thus obtained at the least cost, and that laboratories so placed do not interfere with other uses of a building.

The course of chemical instruction continues to aim at a completely systematized series of studies, while great freedom of development of each branch has found place in the system, stimulated or initiated by the professors or instructors in charge. Reports on these subjects in detail are given as follows: —

Analytical Chemistry. — The number of students in the analytical laboratory at the present time is one hundred and eleven, distributed among the courses as follows: graduate students, two; fourth year, Mining Engineering, seven; Chemistry, one; General Studies, one; third year, Mining Engineering, fifteen; Chemistry, twenty-eight; Biology, two; Sanitary Engineering, two; second year, Civil Engineering, one; Chemistry, thirty; Biology, six; Physics, two; Chemical Engineering, fourteen. The appointment of Mr. Good-

hue, as Assistant in Analytical Chemistry enables Mr. Rolfe to devote his entire time to sugar analysis, and to sanitary chemistry during the second term, and at the same time provides for the entire services of an Assistant in the analytical laboratory, — a much desired gain. The laboratory course of molecular weight determinations is now conducted in a small laboratory partitioned off from the chemical library in Room 39. A larger room is much to be desired, to accommodate more apparatus, thereby enabling more students to work simultaneously. The equipment of the laboratories and offices with electric lights has added much to their efficiency during the dark afternoons of the fall and early winter.

The instruction in analytical chemistry is continued along the same general lines which have been successfully followed for the last few years, with such minor changes as are necessary to keep abreast of the recent progress in this branch of the science. Much stress is laid upon the class-room instruction. One-half of this is devoted to a study of the current literature in German and French. The student is made familiar in this way with the vocabulary which he must command for the investigation of the records of earlier work written in these languages; and at the same time learns the most recent achievements in analytical chemistry. The results seem to show that such reading can best be done under the direction of an instructor to whom the scientific bearing of the subject-matter is familiar. Before the close of the course, the student is enabled to prepare properly a report upon the literature relating to a specific subject distributed through the various journals, in English, French, and German. The instruction in quantitative analysis of the second year will be facilitated by the use of a manual on the subject, prepared by Professor Talbot, with direct reference to the needs of our students.

ORGANIC CHEMISTRY. — For the first time a considerable number of students (six in all), taking the courses in Physics, Biology, or Chemical Engineering, have selected organic laboratory work as an option, or are taking it as an extra

subject. The professional value to chemical engineers of some practical experience with the principles and methods of organic chemistry is very great; and it is unfortunate that lack of time and accommodations have thus far prevented its introduction as a required subject into the Chemical Engineering course. No radical change has been made in the scheme of instruction. The special course of laboratory experiments on the detection and separation of the various classes of organic compounds, inaugurated last year and mentioned in the previous Annual Report, has been considerably extended and improved, by the publication of a text-book to accompany it. So far as is known, a course of this kind is not as yet presented by any other institution. The success which has attended its introduction here is, therefore, worthy of special notice.

SANITARY CHEMISTRY. — It is more and more clearly recognized that a knowledge of the applications of chemistry is fundamental for the solution of problems relating to private and municipal sanitation. The work, therefore, in sanitary chemistry gains in interest and in educational value year by year, and is demanding more time in the curriculum and more space in the laboratories than the present circumstances allow.

The careful and studied selection of the subjects to be considered, and the manner of treating them, enables the students to gain much more than the simple practice necessary to fit them to carry out analyses of water, air, butter, milk, cereals, etc. They acquire a comprehension of the wider and deeper significance of the work undertaken. Original investigation, limited in amount, to be sure, but illustrative and inspiring, is always encouraged; and this, together with a knowledge of many of the practical problems which are constantly brought to the laboratory from all parts of the country, helps to open out to the students the field of scientific and consulting chemistry. The chemists of the sanitary laboratory are engaged, as far as time will permit, on investigations, and standard methods are being continually

developed. On account of limited space very little new apparatus has been placed in commission. A Victoria centrifugal machine has, however, been added to the equipment. The completion of the laboratories at the State House will leave for the exclusive use of our students the best equipped laboratory for water analysis in the country. Exceptional advantages can then be offered to advanced students.

INDUSTRIAL CHEMISTRY. — With the co-operation of the Steam Users' Association, the subject of the corrosion of boilers by soft waters is to be investigated the present winter.

The course in sugar analysis under Mr. Rolfe, which was provided with a separate room last year, has gone on in a satisfactory manner, and two interesting researches in this field are mentioned among the publications of the year.

The instruction in Gas and Oil Analysis has been given by Dr. Gill, upon much the same lines as last year; but, in consequence of the increased size of the classes, a special assistant — Mr. W. L. Root of last year's class — has been appointed. Our experience since the opening of the year has fully justified this step. In Oil Analysis the collection of specimens has been enriched by the gifts of samples of oil from various manufacturers, who have shown a cordial spirit of co-operation with the department. In Gas Analysis, the notes upon the laboratory and of the lectures have been published under the title "Gas and Fuel Analyses for Engineers," which is believed to be the first work of its kind in the English language. The department is much in need of a larger room. Nor is this need restricted to this department alone; the students of Chemical Engineering have for the past two years had no room — as many other courses have, and as they formerly had — which is particularly their own, in which they can study while at the Institute. Furthermore, as this year's class is larger, the want is felt more pressingly than usual of some special laboratory where their theses can be conducted.

Among the features especially characterizing this depart-

ment is the employment of lecturers from the outside to present subjects with which professional practice has made them familiar. The following are the lecturers in Industrial Chemistry, who are not connected with the Institute: F. G. Stantial, S.B., on Sulphuric Acid; H. Carmichael, Ph.D., on Electrolysis of Brine; Chas. D. Jenkins, S.B., on Illuminating Gas, and on Pottery and Tiles; James W. Loveland, S.B., on Soap; Louis J. Schiller, Ph.D., on Sugar and Sugar Refining; Arthur D. Little, on Wood Pulp and Paper. Dr. Thorp has continued his regular course of lectures in Industrial Chemistry. Several excursions to works and factories in the neighborhood of Boston have been made during the year. The thanks of the Institute are due to the managers of these works for their courtesy and hospitality to our students. The number of lectures has been increased this year by twenty, which permits a more complete discussion of many subjects than was possible last year. The number of students in the class is thirty-seven. In Textile Coloring, Mr. Smith has made a change whereby two hours per week are devoted to lectures instead of one hour as formerly. This extra hour has been taken from the time given to laboratory work. Inasmuch as the greater number of dyeing operations require between three and four hours, and none more than four, this was done without curtailing the laboratory work, by utilizing an hour that had often been superfluous.

In conclusion it must be noted that the increase in the number of chemical students has made the old accommodations for lectures and recitations insufficient; there is the greatest difficulty in arranging appropriate hours, and experimental lectures are given an inadequate time for moving apparatus, so that, in this direction almost more than in any other, the need for a new building is felt.

The following publications have been made during the year by members of the Chemical Department:

Theoretical Chemistry.

A. A. Noyes: 1. Die katalytische Wirkung der Wasserstoffionen auf polymolekulare Reaktionen. 2. Bemerkung über das Gesetz der Geschwindigkeit der Reaktion zwischen Eisenchlorid und Zinnchlorur 3. Instruction in Theoretical Chemistry.

A. A. Noyes and H. M. Goodwin: On the Viscosity of Mercury Vapor.

A. A. Noyes and C. W. Hapgood: An Investigation to Determine whether Diphenyliodonium and Thallium Nitrates are Isomorphous.

W. R. Whitney: 1. Untersuchungen uber Chromsulfat-Verbindungen. 2. Translation of "The Elements of Electrochemistry," by M. Le Blanc.

Organic Chemistry.

H. Fay: The Action of Light on Some Organic Acids in the Presence of Uranium Salts.

J. F. Norris (with Ira Remsen): The Action of the Halogens on the Methylamines.

A. A. Noyes and S. P. Mulliken: Laboratory Experiments on the Class Reactions of Organic Substances and their Identification.

A. A. Noyes and C. W. Tucker: Formation of Diacetylenyl from Copper Acetylene.

Analytical Chemistry.

G. Defren: The Determination of Reducing Sugars in Terms of Cupric Oxide.

A. H. Gill: Gas Analyses for Engineers.

J. F. Norris and H. Fay: Iodometric Determination of Selenious and Selenic Acids.

G. W. Rolfe and G. Defren: An Analytical Investigation of the Hydrolysis of Starch by Acids.

H. P. Talbot and A. G. Woodman: Analysis of an Old Rail from an Unused Coal Mine.

H. P. Talbot: A Brief Course of Quantitative Analysis.

Sanitary Chemistry.

G. Defren: The Determination of Nitrites in the Air.

E. H. Richards and G. W. Rolfe: The Reduction of Nitrates by Bacteria and Consequent Loss of Nitrogen.

E. H. Richards: 1. Water and Air as Food. 2. The Teaching of Sanitary Chemistry. 3. Some Points in the Use of Depth of Color as a Measure of Chemical Contents. 4. Municipal Responsibility for Healthy School Houses. 5. Hardness of Water and the Methods by which it is determined. 6. Hospital Diet. 7. The Chemistry of Cooking and Cleaning. (New Edition.)

Inorganic Chemistry.

H. P. Talbot: On the Volatility of Ferric Chloride.

F. H. Thorp: 1. Manual of Inorganic Chemical Preparations. 2. A Review of Some Improvements in Chemical Industry.

Courses VI. and VIII., Electrical Engineering and Physics. — Very substantial additions have been made to the material for instruction in Physics and Electrical Engineering. Especially is this true regarding instruments of precision. Besides duplicating much apparatus of this kind already possessed, various new instruments have been added. Among these should be mentioned the gift by Mrs. Draper of a mechanical air-pump, a mercurial air-pump, and two dynamo-machines, which were used by the late Dr. Henry Draper in his researches. There has also been presented by the General Electric Company an Edison potential regulator, an instrument of much historical interest. We have made a great addition to our lantern-slides, about five hundred having been added. These have all been made in our own laboratory by Mr. Derr. A valuable addition to the workshop of the department has been made in the shape of a Fitchburg engine lathe with fourteen-inch swing. As an illustration of the exceptional manner in which the needs of our classes of students are provided for, it may be mentioned that we have fifty ampere-meters and volt-meters of the first grade of excellence

for accurate work, in addition to many of a less degree of precision.

Especially important is the large increase of our dynamo-electric machinery. During the past year there have been added a 30-arc light (2,000 candle-power) Brush machine; a 30-horse-power 4-pole direct-current Westinghouse machine; and a 10-horse-power Westinghouse direct-current machine, arranged so as to give also quarter-phase alternating currents when desired. This last mentioned machine can be used either as a direct or alternating-current motor, or as a rotary transformer. There have also been added two 20-horse-power transformers for electric-lighting currents, a transformer, giving a pressure of 40,000 volts, for the study of the insulating power of different materials, and a low-voltage transformer for the production of very heavy currents up to 3,000 amperes, besides several dynamo machines of smaller capacity. Still more important is the new experimental plant of combined dynamo and steam engine, the need of which was urged in the President's Report of last year, and its purchase authorized by the Executive Committee in the spring of 1896. This is now in process of installation. It consists of two similar 4-pole moderate-speed direct-current generators of 35-horse-power each, made by the General Electric Company. These are driven by a belt connection from a Westinghouse compound engine of 105-horse-power at 125 pounds steam pressure. This engine will be furnished with condensers and weighing tanks, for weighing the exhaust steam, and with an indicator rig. The plant is especially designed for purposes of accurate testing and measurement. A special switch-board will allow of all desirable electrical combinations of the dynamo machines.

Next to thorough and accurate teaching, perhaps nothing is more important in a professional course than the manner in which it is laid out, — the sequence of studies and the relative time assigned to each branch. The increased entrance requirements in Mathematics, the effect of which is now being felt in the upper years, are bringing about a marked improve-

ment in all the courses of instruction. In the courses in Physics and Electrical Engineering, in which there is desired an early introduction of more advanced mathematical methods than have hitherto been available, the gain is particularly helpful. Its full advantage will not be secured until next year, when the fourth-year class will for the first time proceed under the revised schedule, but improvement is already manifest in the work of the second and third years.

The principal change which proved feasible in the past year was the introduction of a new course of fifteen lectures given by Professor Cross in the first term of the third year, devoted to the principles of dynamo-electric machinery, and its applications to electric lighting, the electrical generation, transmission and utilization of power, and similar topics. This is to serve as an introduction to the more specific and technical treatment of these subjects in the last year of the course. After the present year, these lectures will also be attended by students of the courses in Civil, Mechanical, Mining, Chemical, and Sanitary Engineering, and in Chemistry. The exercises in memoir work, which for many years past have been held in connection with the fourth year of the Course in Physics, have been somewhat modified in a way decidedly to increase their value. A Physical Colloquium is now held once each fortnight throughout the year, under the direction of Dr. Goodwin; and much more practice than formerly is given in making abstracts of current literature in foreign languages. The course in Heat Measurements was given last year by Mr. Norton, that in Precision of Measurements by Professor Clifford, and that in Electrical Measuring Instruments by Mr. Laws, as the condition of Professor Holman's health was such as to forbid his taking charge of them. Mr. Laws also took the immediate charge of the Laboratory of Electrical Measurements. Several new courses of lectures to be opened in the department this year should be referred to here. The first of these, by Professor Clifford, will be devoted to an extended discussion of the Electromagnetic Theory of Light, intended especially

for the benefit of graduate students and advanced students of the Course in Physics. The second, by Mr. Derr, will be devoted to the subject of the theory and practice of Photography, and will be open to members of the three upper classes. It is hoped that in time this course may be extended to include a consideration of the arts of photo-mechanical printing and other like processes, which, as far as I am aware, are not at present discussed in any of our technical schools.

A course of combined lectures and laboratory exercises in Dynamo-Electric Measurements has been given for the first time by Professor Puffer to third-year students in Mechanical and Mining Engineering. This runs parallel with the lectures on the Industrial Applications of Electricity, already mentioned, which are also taken by these students. Instruction is given in the simpler methods of testing dynamo-electric machinery. The course of lectures in Electrical Measuring Instruments, given by Mr. Laws to students in Electrical Engineering and Physics, has been extended into the fourth year, in order to allow of a more detailed consideration of the measurement of alternating currents. During the past year a number of valuable papers, mostly based upon work done in the Physical Laboratory, have been published from the department in the "Proceedings of the American Academy," the "Technology Quarterly," and elsewhere. In the spring, extended experiments were carried on in the department in connection with the newly discovered "X-Rays" of Röntgen, and various important observations were made. Among these may be especially mentioned the independent discovery by Dr. Goodwin of the fact that these rays act to dissipate both negative and positive charges. The fact had not before been known in this country, and its original publication abroad was only a few days earlier. Messrs. Norton and Lawrence gave much assistance to Dr. F. H. Williams, of the Corporation, in developing an apparatus that should be suitable for ready use in surgery and medicine.

In my last Report I emphasized the difficulties sustained by this department from the entirely inadequate amount of room at its disposal. The great pressure which this restriction places upon the work of the fourth year in Electrical Engineering and Physics cannot be other than detrimental to its success. That it is not far more so is due only to most earnest effort on the part of teachers and pupils alike. In some of our higher work in Physics we now find ourselves in a position where it is difficult even to continue the work which we are doing. I refer to the courses in Heat Measurements and Physical Chemistry. It is over ten years since Professor Cross proposed the creation of a laboratory for the investigation of problems in heat, analogous to the laboratory of electrical measurements. For various reasons the institution of such a course in heat measurements and the establishment of such a laboratory were much delayed. This was finally done, however, the work being undertaken by Professor Holman; but no additional room could be obtained for it, so that a narrow strip had to be taken from one of the rooms constituting the laboratory of electrical engineering. This room, 16 × 29 ft., is all that we have now for this important work. Even this is not available except in the first term, as in the second term it has to be occupied in part for thesis work in electrical engineering or physics. The number of students taking Heat Measurements will be increased next year by the whole fourth-year class in Mining Engineering, which is likely to more than double the total number of those pursuing this subject. It is impossible to see how the needs of these students are to be met.

Even more serious at the present time is the fact that the laboratory of Chemical Physics, which was opened two years ago (the room for this also being taken from the laboratory of electrical engineering), is now crowded beyond its utmost capacity. It has been necessary to carry on some of the thesis work in Physics in this room. Up to the present time this has been possible, and not incompatible with the work of instruction in chemical physics. But the simultaneous in-

crease in the number of students in the Course in Physics, and the introduction of chemico-physical work into the Course in Chemistry, which latter course is rapidly increasing in numbers, is putting us in a most serious position. If nothing beyond the present room is to be available, the only apparent remedy is to cease to give a portion of the instruction which has been undertaken. This at least is feasible; and objectionable as such a procedure would be, it seems preferable to carrying on such work in an inefficient manner, which would be demoralizing alike to students and teachers. The work in heat measurements and chemical physics is of such present and growing importance as to demand for its full success a space comparable with that allotted to the laboratory of electrical measurements. There is, furthermore, as last year, a painful lack of general lecture and class-room accommodations. Were the pressure for room in the above mentioned directions less severe, I should call attention to the crowded state of the study-room and library (No. 14), and the need of more room for the safe-keeping of apparatus. The uniformly good order and quiet maintained by the students has, however, prevented detriment from the former of these causes.

Course VII., Biology. — For several years the Institute largely through the co-operation of the Biological Department with the Departments of Chemistry and Civil Engineering, has occupied the leading position in sanitary science among schools of engineering in the United States. The importance of this position is obvious when it is realized that some of the greatest engineering undertakings of the present time — such, for example, as the gigantic scheme of a metropolitan water supply for Boston and the more than two score cities within the Boston Basin — owe their origin chiefly to the enlightened demands of modern sanitary science.

The present year marks another notable development of the work of the Biological Department on the technological side, by the establishment of a regular course of lectures and laboratory work in Industrial Biology. As it is believed that

such a course is entirely new in the United States, it requires more than passing notice.

The rapid progress of bacteriology has made necessary an entirely novel point of view in the arts and industries dependent on the activity or the exclusion of micro-organisms. Some industries, such as brewing, the leavening of bread, the making of butter and cheese, and the manufacture of vinegar, depend upon the successful cultivation and co-operation of micro-organisms (yeasts, molds, and bacteria), — facts which are often unknown even to those engaged in these arts or industries. Within two or three years the cultivation of butter-making bacteria has become of practical importance, and many creameries now use pure cultures of bacteria for the "ripening" of their cream as a preliminary to churning, instead of trusting to chance, as does the housewife, that the right micro-organisms shall fall in, and as was the universal custom, even in creameries, until very recently. In this new departure the Biological Department of the Institute has taken a prominent part, one of its graduates and former instructors being now engaged commercially in the propagation of the necessary butter bacteria for this new industry.

One of the latest developments along a similar line is the investigation of the bacteria of tanneries. It has long been known that hides and skins are fermented with great advantage after the hair has been removed from them, and before they are put into the tan-liquor. One of the instructors in Biology has for the past few months been carefully studying the micro-organisms concerned in these fermentations, and with most interesting and valuable practical results for the leather making industry.

Other industries, such as the preparation of canned foods, cold storage, drying, salting, smoking, and pickling, depend for their success not on the activity, but on the exclusion, inhibition, or destruction of micro-organisms. In this direction also much is being done. The causes of the spoiling of canned clams and lobsters are under investigation, with every indication of success and ultimate escape from the heavy

losses now entailed upon the manufacturer by imperfect processes. Some of these processes are briefly treated in works on industrial chemistry, but the time has now come when they must be more carefully studied from the biological standpoint, and to this end a course of three hours a week, for a half year, was established, and is now under way. It is open to graduate, senior and special students in Biology and Chemistry, and runs parallel with the course in general Bacteriology, of which it may be considered an outgrowth. Developments like these, in applied biology, make it not less but more necessary to maintain the purely scientific work of the department which underlies and supports them. The work in Physiology and Hygiene continues to be ably conducted by Assistant Professor Hough; that in Zoölogy and related subjects is in charge of Dr. Weysse; the instructor in Botany is Mr. Prescott, who also assists Professor Sedgwick in his courses in General Biology, Bacteriology, Industrial Biology, Microscopy, etc. Through the generosity of Augustus Hemenway, Esq., the equipment has been materially strengthened by the addition of several costly high-power microscopes, which were greatly needed on the bacteriological side. To Mrs. William B. Rogers the department of Biology is once more indebted for the use of tables in the Marine Biological Laboratory, at Wood's Hole, which were occupied with great advantage, during the summer, by Mr. Prescott and Mr. Stiles, a fourth-year student.

One of the most gratifying features of the year has been the resort to this department of several graduate, or advanced special students, who desire to make particular investigations chiefly in sanitary or industrial Biology. Every effort has been made to provide suitable accommodations for them; but the painfully congested state of the single room which still is made to serve for the steadily growing needs of the department has rendered it impossible for us to do for them what we should have been glad to do. Further adaptation has become impossible. Professor Sedgwick has only been able to meet the demands of the present year, and that

inadequately, by taking two workers into his own small office.

Course IX., General Studies. — I have spoken of the large amount of material, maps, charts, and diagrams, which has been prepared for illustrating the first and second-year courses in history which are taken by all regular students. The same aids are introduced into the course in the history of the Renaissance and the Reformation taken by third and fourth-year students of the Courses in Architecture, Biology, and General Studies.

Furthermore, for the history of the Renaissance several hundred of the best isochromatic photographs, many of them in carbon or platinum, were purchased for the department by Mr. Sumner while in Europe last summer. In this selection, the historical interest of the subject, as notably in the case of portraits, as well as the importance of the work in the development of art, was emphasized. This collection illustrates the development of Romanesque, Gothic, and Roman sculpture, both in Italy and the North of Europe. For purposes of comparison, a few photographs from the early German and Flemish masters are included. I very highly approve of Professor Currier's suggestion that, as soon as it can be done, arrangements be made for a permanent exhibition of these photographs in such a way that some considerable part of them may be displayed at any given time, other sections of the collection being introduced into the frames at stated times, so that all may be brought under the observation of the student in the most effective way.

It is a proper subject for congratulation that Professor Dewey has been appointed by the Governor a member of the State Commission, created under a recent law, to investigate the charitable and reformatory interests and institutions of the State. It will be remembered that, three years ago, Professor Dewey was called to serve the State as chairman of the commission appointed to investigate the subject of the unemployed. I consider it sound policy for an institution of the higher learning liberally to encourage its professors to

connect themselves with the public service, and with the active interests of the community in every way, and to every degree which may be compatible with the full and proper performance of their duties as teachers. Altogether in addition to the consideration of the service that may be thereby performed for the state and its citizens, I believe that the teachers bring back to their classes from such work and service much which is of great value to the student. It is in order also to make reference to Dr. Ripley's recent publications on Anthropology, and his Lowell lectures of the present season, on the same subject, which will be collected and published in book-form next year.

Another graduate in the course in General Studies at the Institute of Technology, Mr. William Herbert King, has been appointed to a fellowship at Columbia University. Mr. King is the third graduate from this course who has received that honor from Columbia University. A new circular has been prepared for the General Course, the issue of 1891 having become exhausted, and the changes of the intervening years being numerous and important.

Course XII., Geology. — The instruction in Geology and Mineralogy is largely auxiliary to courses in certain other departments. The classes in the general subjects are large, and the students show a commendable appreciation of the work.

The combination of studies in the schedule of the course has met with the approbation of working geologists and men of science. The demand for our graduates is so good that they have been more successful in obtaining satisfactory positions than is usual in professional life.

Three students took their degree in the department of Geology last June, two of whom had then accepted appointments for the present year, while the third was only prevented by temporary disability from engaging in work.

Much of the work of the students in the department last year is worthy of notice. Mr. A. W. Grabau's graduation thesis was "Characteristics and Succession of the Fossil

Faunas of the Middle Devonian (Hamilton) at Eighteen Mile Creek, New York;" and he has continued the same line of investigation in an extended and critical study of the fossil faunas of the Hamilton Group in Western New York, which is ready for publication in the official Reports of the Survey of that State.

The work represented by the graduating thesis of Mr. Myron L. Fuller has been amplified with the assistance of Professor Crosby, and will be published as a joint paper in the "Technology Quarterly" and the "American Geologist." A study which Mr. Fuller made as a student has been published in the Proceedings of the Boston Society of Natural History under the title of "A New Occurrence of Carboniferous Fossils in the Narragansett Basin."

In the preparation of her thesis upon "The Geological History of Lake Cochituate" Miss Elizabeth F. Fisher made a study worthy of record, and it is to be hoped that her observations may be extended and the results published. Miss Fisher is now Instructor in Geology in Wellesley College.

The increased interest in nature studies has enforced requests from the teachers of science in the public schools for opportunities for laboratory practice in mineralogical and geological work. It is believed that a cordial response on the part of this department will add to the reputation of the Institute and aid the Commonwealth in its educational work. The Faculty has voted to introduce a course in Geological Laboratory work for special students.

The collections in Economic Geology, Mineralogy, and Paleontology have been improved in quality and extent. Each year the material is being better selected, arranged, and labelled, — a work which must be performed in the intervals of more pressing duties, and which requires a great deal of time and patience. The constant wear of maps, diagrams, and apparatus, and the advance of science have necessitated the replacing of some of the old by new and improved appliances. The geological library is steadily receiving accessions.

Course XIII., Naval Architecture. — The work of this department has gone steadily on during the year; but there have been no changes of sufficient importance to require to be indicated here. The need of a separate drawing-room for the students in Naval Architecture has been pointed out elsewhere in this Report. By permission of the Secretary of the Navy, and through the courtesy of Chief Naval Constructor Philip Hichborn and Commodore Miller, commandant of the Boston Navy Yard, the department has been able to give instruction in mould-loft work, for two years past, just after the close of the school year. The first year the instruction was given by an experienced mould-loft man, under the direction of Mr. Swan. Last year the instruction was given by Mr. Swan, assisted by Mr. Clark. The work lasted about ten days, during which the students learned to perform all the ordinary operations of the mould-loft, and laid down nearly all the lines for an important ship. It is found that students who have learned to draw ship-lines on paper, and who are familiar with the principles of descriptive geometry, learn mould-loft work rapidly, and that they take a great interest in their work. I do not know that this particular work is given in any other technical school of our grade.

Mr. James Swan, who has since 1893 been Professor Peabody's principal assistant, has been given a leave of absence for a year, to enable him to pursue advanced studies in shipbuilding at the University of Glasgow. His work this year is being carried on exceedingly well by Mr. Clark. I entertain no doubt that Mr. Swan will bring back from his foreign study much which will be of use in the further development of our course in Naval Architecture. Professor Peabody reports that all his last year's graduates are engaged upon professional work.

This concludes the history of the Institute since I last had the honor to make my report to the Corporation. Much might be added; but I have, I trust, given details enough to show the real condition of the school, and its most important

needs. I cannot close without a word to express the grief and sense of loss which the death of Mr. Bouvé has brought to the Faculty of the Institute. Notwithstanding his impaired strength and the infirmities which for years have made life a burden to him, he did not even diminish the attention which he had been wont, from the foundation of the school, to give to the interests and needs of the departments of Geology and Mining and Metallurgy. No school ever had a better adviser. When the history of this school shall be fully written, the name of Thomas T. Bouvé will be found high up on the roll of its founders and early directors.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30th, 1896.

The results this year are far more satisfactory than last, and show a balance of twenty-three hundred and fifty dollars and twenty-seven cents on the credit side of the account, instead of a deficit of fifteen thousand nine hundred and thirty-five dollars and twenty-nine cents, as was the case the preceding year. This favorable change is due for the most part to the generous grant of twenty-five thousand dollars made by the Commonwealth. The unfavorable side of the matter is that whereas the grant was twenty-five thousand, the balance is only a little over two thousand; and further, that the grant is only to continue for five years more.

Both repairs and general expenses have increased, and this is in part due to the overcrowded condition of the buildings. The effort to accommodate more students leads to many changes, which are in no sense permanent improvements. The need for a new building is becoming imperative, but the money for such an extension is lacking.

Generous gifts have been received during the past year.

Under the will of Ann White Vose, $52,827.36 have been added to the scholarship funds; and through the generosity of Charles H. Dalton, Esq., the Dalton Graduate Chemical Fund of $5,000 has been established.

The William Hall Kerr Library Fund of $2,000 was given by Mrs. Kerr in memory of her husband, and $500 were received from Augustus Hemenway, Esq., for the Biological Department. Mrs. William B. Rogers gave $200 for the purchase of periodicals, and from other friends came $400 for the Chemical and $250 for the Mathematical Departments.

There have also come to the Institute the following legacies and devise, which are not restricted to any special use, and are available, either as to income, or as to both principal and income, for the general purposes of the Institute: —

Henry E. Hutchins,	legacy	$2,000 00
Moses Kimball	"	5,000 00
Benjamin P. Cheney	"	10,000 00
Samuel E. Sawyer	"	4,414 66
Catherine P. Perkins	" (additional)	6,568 40
Susan G. Coolidge,	devise	14,500 00

As a result of all the above gifts, there has been a net increase in the property of the Institute to the amount of $107,178.10, of which more than half is for scholarships. The value of such scholarship funds is very great. They enable many excellent students to obtain the benefits of an education which they must otherwise forego. The average standing and scholarship of those receiving this aid is very high, and there can be no doubt that they will turn to good account in after-life the training which these generous gifts place within their reach. To these most deserving students the benefit is a great and a lifelong one.

As a purely financial matter, however, these scholarship endowments do not enrich the Institute at all or aid it to meet its expenses, as will readily be understood when it is borne in mind that the average student costs the Institute annually in cash payments about two hundred and sixty-seven dollars, while the tuition fee is only two hundred dollars. In fact, the student really receives from the Institute much more than two hundred and sixty-seven dollars, since he has also the use of the buildings and scientific apparatus. To meet the excess over the tuition fees the Institute must rely on the general, unrestricted funds, and it is only through these that its work can be continued. It is therefore important that the friends of the Institute should understand, — first, that scholarship gifts are most gratefully received, and do a most important work; but, second, that such gifts make only more necessary the gift of unrestricted funds with which to meet the general expenses of the Institute.

SECURITIES SOLD OR PAID, W. B. ROGERS MEMORIAL FUND.		
$7,000 Omaha & Southwestern R. R. 8s. 1896 . .		7,000.00
SECURITIES SOLD OR PAID. GENERAL FUND.		
$1,000 Union Pacific R. R. 6s. 1898	1,050.00	
27 Shares Essex Co. dividend of capital . . .	270 00	
		1,320.00
PURCHASE OF SECURITIES, W. B. ROGERS MEMORIAL FUND.		
$6,000 New York & New England R. R. 1st 6s. 1905		6,750.00
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT.		
50 Sh. New York, New Haven & Hartford R. R.	8,000.00	
Real Estate, Main Street, Cambridge	16,154.38	
37 Sh. Nat. Mechanics Bank, Baltimore	706.70	
10 Sh. First Nat. Bank of Baltimore	1,293.30	
16 Sh. Boston Real Estate Trust	18,400.00	
$5,000 New York & New England R. R. 1st. 6s. 1905	5,612.50	
		50,166.88

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 30, 1895		21,807.33
From Augustus Lowell for Lowell Courses	5,825.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		8,825.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,942.00	
" " " " scholarships (students' fees)	4,269.12	
" " " " " " " 1895	705.88	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " Library	495.00	
" " " " general purposes	9,187.60	
" " Rogers Memorial Fund	9,570.09	
" " Charlotte B. Richardson Fund,	1,682.04	
Students' fees	216,767.50	
State Scholarships	2,000.00	
State Agricultural Fund	5,592.52	
State Endowment Fund	7,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	8,739.74	
Rents, per Table (page 92)	13,306.58	
Gifts	1,558.07	
Interest	3,670.41	
Boston University	1,150.00	
Sale printed Lecture Notes	3,006.12	
		318,976.01
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Richard Perkins Fund,	470.93	
" James Savage Fund,	179.31	
" Joy Fund	567.87	
" Letter Box	111.00	
" Susan Upham Fund,	51.35	
" W. B. Rogers Fund, additional	50.00	
Susan E. Dorr Fund	115.09	
Arthur Rotch Prize Fund	225.00	
Arthur Rotch "Special" Prize Fund	225.00	
T. Sterry Hunt Fund, additional	82.74	
Ann White Vose Fund	53,232.36	
Dalton Graduate Chem. Fund	5,090.00	
Wm. Hall Kerr Library Fund	2,000.00	
Biological Instrument Fund	500.00	
Mathematical Department Fund	250.00	
		63,150.65
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry E. Hutchins Legacy	2,000.00	
Moses Kimball Legacy	5,000.00	
Benj. P. Cheney Legacy	10,000.00	
Susan G. Coolidge Devise	14,500.00	
Samuel E. Sawyer Legacy	4,414.66	
Catherine P. Perkins Legacy (additional)	6,568.40	
		42,483.06
SECURITIES SOLD OR PAID. GENERAL FUND, page 83		1,320.00
" " " Rogers Fund, page 83		7,000.00
SUNDRIES.		
Income credited to Bond Premium Acc't	533.90	
Income credited to Rogers Bond Premium Acc't	521.41	
Boston Art Students' Asso. on acc't	666.66	
Students notes paid	950.00	
Profit and Loss, per page 85	2,350.27	
		5,022.24
		$468,584.29

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPTEMBER 30, 1896.

Cr.

Paid for Lowell Courses	5,825.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,825.00
EXPENSES.		
Salaries, per Table (page 92)	217,028.58	
" paid from Gifts	500.00	
Fellowships paid from Swett Fund	400.00	
" " " Savage "	400.00	
Repairs, per Table (page 95)	9,403.17	
General Expenses, per Table (page 93)	14,631.46	
Fuel	9,025.20	
Water	1,775.65	
Gas	2,254.81	
Electricity	782.01	
Printing and Advertising	2,360.37	
" Lecture Notes	3,708.93	
" Annual Catalogues and Reports	2,629.89	
Rents paid Boston & Albany R. R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 92)	37,564.99	
Society of Arts	939.43	
Casts, &c., Rotch Fund	292.60	
Photograph, Gift	216.07	
Interest 4.50 per cent on funds not in stocks and bonds	5,765.63	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	5,566.95	
Profit and Loss. Income more than expenses	2,350.27	
		318,976.01
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 83		50.166.88
PURCHASE OF SECURITIES WM. B. ROGERS MEMORIAL FUND, page 83		6,750.00
Income of Joy Fund, deposited		567.87
Projected Building, Trinity Place, plans		169.50
SUNDRIES.		
Notes Receivable	60,000.00	
Students' Deposits	100.00	
Scholarship Funds, 1895 used	705.88	
		60,805.88
Cash balance, Sept. 30, 1896		22,323.15
		$468,584.29

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1896 : —

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$50,000.00	Saginaw & Western R. R. 6s.	1913	50,000.00	
30,000.00	Burlington & Mo. River R. R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R. R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R. R. 5s.	1925	16,000.00	
6,000.00	New York & New England R. R. 6s.	1905	6,000.00	
5,400.00	Republican Valley R. R. 6s.	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R. R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R. R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R. R.			
	1,000 General Mortgage 4s.	1934		
	2,000 Income 5s.	1934		
			2,221.40	
1,000.00	Lincoln & Northwestern R. R. 7s.	1910	1,000.00	
1,000.00	Atchinson & Nebraska R. R. 7s.	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R. R. 5s.	1922	24,000.00	
	Advances to Bond Premium account.		8,400.00	
	Bonds			250,453.90

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	5,000.00	
	Deposits in Savings Banks	4,123.70	
			9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.	10,000.00

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R. R. 6s. non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R. R. 6s. exempt	1918	2,000.00	
6,000.00	Chicago, Burlington & Quincy R. R. 4s.	1922	5,100.00	
3,000.00	Milwaukee & St. Paul R. R. 7 3-10	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R. R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R. R. 7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R. R. 6s.	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R. R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s.	1913	2,000.00	
35,000.00	Fitchburg R. R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R. R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R. R. 4s.	1951	3,000.00	
5,000.00	New York & New England R. R. 6s.	1905	5,000.00	
	Advances to Bond Premium account		5,539.84	
	Bonds			195,639 84
	Amount carried up			$465,217.44

Amount brought up					465,217.44

STOCKS.

SHARES.					
148	Boston & Albany R. R.	par	100	29,933.00	
194	Morris & Essex R. R.	"	50	14,690.00	
40	New York & Harlem R. R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R. R.	"	100	12,880.00	
50	N. Y., New Haven & Hartford R. R.	"	100	8,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
1	Laconia Co.	"	400	605 00	
2	Pepperell Manufacturing Co.	"	500	2,300.00	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
15	Consolidated Gas Co., New York	"	100	1,447.50	
7	Lowell Gas Light Co.	"	100	1,610.00	
40	Cambridge Gas Light Co.	"	100	7,000.00	
7	Lawrence Gas Light Co.	"	100	882.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
10	First Nat. Bank of Baltimore	"	100	1,293.30	
16	Boston Real Estate Trust	"	1000	18,400.00	
					178,455.50

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, Trinity Place	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architects' "		57,857.10	
Lot No. 2 Trinity Place		137,241.60	
Projected Building, Trinity Place, plans . . .		169.50	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Main Street, Cambridge . . .		16,154.38	
			989,309.06
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.36	
			37,183.80

SUNDRIES.

Notes Receivable	61,500.00	
Boston Art Students' Association	13 000.00	
Students' Notes	2,783.00	
Cash Balance, Sept. 30, 1896	22,323.15	
		99,606.15
		$1,769,771.95

The foregoing Property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,414.66	
		429,393.90

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	53,175.17	
James Savage Fund	13,252.82	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,374.27	
Joy Fund	9,123.70	
Elisha Thacher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,675.78	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,082.74	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	53,232.36	
Dalton Grad. Chemical Fund	5,090.00	
		195,981.44

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund	37,378.78
Susan Upham Fund	1,192.47
Susan E. Dorr Fund	2,672.65
William Hall Kerr, Library Fund	2,000.00
Biological Instrument Fund	500.00
Mathematical Department Fund	250.00
Charles Lewis Flint, Library Fund	5,000.00
Rotch Arch. Library Fund	5,000.00
Rotch Architectural Fund	25,000,00
Arthur Rotch Prize Fund	5,225.00
Arthur Rotch "Special" Prize Fund	5,225.00
Letter-Box Fund, balance	170.12

MISCELLANEOUS.

Notes Payable	150,000.00	
Students' Deposits	500.00	
Catherine P. Perkins Legacy, 1893	102,781.40	
Henry E. Hutchins Legacy, 1895	2,000.00	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000.00	
Susan G. Coolidge Devise, 1896	14,500.00	
M. I. T. Stock Account	682,401.19	
		967,182.59
		$1,769,771.95

Comparative Statement of Funds, etc.

	Sept. 30, 1895.	Sept. 30, 1896.
Trusts for general purposes	424,979.24	429,393.90
" " Salaries	87,600.00	87,600.00
" " Scholarships	137,014.11	195,981.44
" " Library	5,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Letter-Box Fund	59.12	170.12
Notes Payable	150,000.00	150,000.00
Students' Deposits	600.00	500.00
Martha Ann Edwards Legacy	98,452.89	
T. O. H. P. Burnham "	20,000.00	
Catherine P. Perkins "	96,213.00	102,781.40
William J. Walker "	21,136.00	
Susan Upham Fund	1,141.12	1,192.47
Susan E. Dorr Fund	2,557.56	2,672.65
Henry E. Hutchins Legacy		2,000.00
Moses Kimball "		5,000.00
Benj. P. Cheney "		10,000.00
Susan G. Coolidge Devise		14,500.00
Biological Instrument Fund		500.00
Mathematical Department Fund		250.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Architectural Library Fund	5,000.00	5,000.00
Arthur Rotch Prize Fund	5,000 00	5,225.00
Arthur Rotch "Special" Prize Fund	5,000.00	5,225.00
M. I. T. Stock Account	540,462.03	682,401.19
	$1,662,593.85	$1,769,771.95
Increase		
Consisting of: —		
Bequests for Special Purposes, etc. See page 84		63,150.65
Gifts and Bequests for General Purposes. See page 84		42,483.06
Income more than Expenses		2,350.27
		107,983.98
Less Scholarship Funds, 1895, used	705.88	
" Students' Deposits	100.00	
		805.88
		$107,178.10

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,942.00	From Dividends, Bank Stocks	1,080.00
" " Scholarships	4,269.12	" State Tax returned on Bank Stocks	242.59
" " " James Savage Fund	400.00	" Bonds	9,221.12
" " Charlotte B. Richardson Fund	1,682.04	" Dividends, Railroad Stocks	2,678.00
" " Library	495.00	" " Coal and Gas Stocks	1,910.00
" " General Purposes	9,187.60	" " Manufacturing Stocks	1,248.00
" " Increase of Funds	1,761.68	" Real Estate Stocks	126.00
" " Advances to Bond Premiums	533.90	" Interest allowed on Funds not in Bonds and Stocks @ 4½ %	5,765.63
	$22,271.34		$22,271.34

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology .	9,570.09	Received Income from Railroad Bonds . . .	10,091.50
Credited to Advances Bond Premiums . . .	521.41		
	$10,091.50		$10,091.50

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		400.00	
State Board of Health, for use of Laboratories		750.00	
Land and Building, Clarendon St., on account		4,750.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will	1,000.00		
less Tax and Repairs	368.26		
	1,368.26		
		831.74	
Use of Rooms and Gymnasium		1,274.84	
			13,306.58

Department Supplies.

Chemistry	10,119.38	
Physics	7,981.90	
Mining	2,199.32	
Mechanical Engineering	2,779.24	
Naval Architecture	512.35	
Applied Mechanics	1,509.75	
Civil Engineering	2,724.56	
Biology	2,140.93	
Geology	907.19	
Architecture	2,147.24	
Drawing	38.75	
Mathematics	110.89	
English	1,381.43	
Workshops	1,614.68	
Modern Languages	134.54	
Periodicals	1,262.84	
		37,564.99

Salaries.

Instruction	178,445.40	
Administration	20,165.91	
Labor	18,417.27	
		$217,028.58

Repairs.

Department Improvements: —			
Chemistry	1,679.03		
Mechanical Engineering	720.43		
Physics	370.24		
Workshops	297.86		
English	281.92		
Civil Engineering	226.79		
Mining	191.92		
Biology	166.13		
Applied Mechanics	125.72		
Geology	89.11		
Mathematics	79.17		
Architecture	29.30		
Modern Languages	5.62		
Naval Architecture	5.30		
Drawing	1.87		
		4,271.31	
Rogers Building		1,170.50	
Walker "		954.67	
Sundries		821.36	
Steam Fitting		778.75	
Architectural and Engineering Buildings		686.46	
Gymnasium		399.57	
Boilers, Tools, etc.		145 00	
Ventilation, Huntington Hall		112.80	
Lowell School of Design		31.25	
General Library		25.88	
Military Department		5.62	
			$9,403.17

General Expenses.

Electric Wiring	2,148.85	
Stationery and Office Supplies	1,789.40	
Fire Insurance	1,683.20	
Postage	1,173.00	
Entrance Examinations	868.22	
Sundries	808.03	
Diplomas, Commissions, and Expense of Drill	732.07	
Washing	713.13	
Furniture	558.73	
Janitor's Supplies: Brushes, Pails, etc.	462.63	
Express Charges, Teaming, etc.	429.23	
Window Shades	402.39	
Lowell School of Design	387.82	
Gymnasium Supplies	377.42	
Examination Books	287.50	
Paints, Varnish, etc.	239.47	
Ice	237.48	
Engine Room Supplies: —		
Oil	153.12	
Cotton Waste	69.65	
	222.77	
Amount carried forward	$13,521.34	

Amount brought forward	13,521.34	
Transformer for Physical Department	214.95	
Books, Supplies, etc., for General Library	193.90	
Mechanics' Fair, Atlanta and Swedish Exhibits	150.47	
Tennis Court	99.89	
Type-Writing Machine	97.60	
Glass	87.11	
Telephone & Telegraph Co.	85.58	
Military Department	83.62	
Union Safe Deposit Vaults	50.00	
Western Union Telegraph Co	27.00	
Legal Fees	20.00	
		$14,631.46

BOSTON, Dec. 4, 1896.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending Sept. 30, 1896, has been made, and they are found to be correctly cast, and with proper vouchers. The ledger balances agree with the trial balance. We have verified the evidences of personal property held by the Institute.

C. C. JACKSON,
JAMES P. TOLMAN,
CHARLES FAIRCHILD,
Auditing Committee.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 8, 1897.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1898.

Members of the Corporation.

President.
JAMES M. CRAFTS.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.	THORNTON K. LOTHROP.
FREDERIC W. LINCOLN.	CHARLES C. JACKSON.
WILLIAM ENDICOTT, JR.	SAMUEL M. FELTON.
JOHN CUMMINGS.	DESMOND FITZGERALD.
AUGUSTUS LOWELL.	SAMUEL CABOT.
HOWARD A. CARSON.	FRANCIS BLAKE.
CHARLES J. PAINE.	CHARLES W. HUBBARD.
CHARLES FAIRCHILD.	THOMAS L. LIVERMORE.
DAVID R. WHITNEY.	A. LAWRENCE ROTCH.
ALEXANDER S. WHEELER.	JOHN R. FREEMAN.
JAMES P. TOLMAN.	GEORGE A. GARDNER.
HOWARD STOCKTON.	WILLIAM H. LINCOLN.
ELIOT C. CLARKE.	J. B. SEWALL.
NATHANIEL THAYER.	THOMAS GAFFIELD.
CHARLES F. CHOATE.	CHARLES L. LOVERING.
HIRAM F. MILLS.	A. LAWRENCE LOWELL.
PERCIVAL LOWELL.	SAMUEL JOHNSON.
ARTHUR T. LYMAN.	JAMES P. MUNROE.
CHARLES MERRIAM.	WILLIAM L. PUTNAM.

CHARLES G. WELD.

On the Part of the Commonwealth.

HIS EXCELLENCY GOV. ROGER WOLCOTT.
HON. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

JAMES M. CRAFTS. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }

FRANCIS H. WILLIAMS. AUGUSTUS LOWELL.
THOMAS L. LIVERMORE. ALEXANDER S. WHEELER.
HOWARD STOCKTON.

Finance Committee.

WILLIAM ENDICOTT, Jr. CHARLES C. JACKSON.
DAVID R. WHITNEY. NATHANIEL THAYER.
SAMUEL JOHNSON.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Committee on the Lowell School of Industrial Design.

PERCIVAL LOWELL. JOHN D. RUNKLE.
WILLIAM H. LINCOLN.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

AUGUSTUS LOWELL. FREDERIC W. LINCOLN.
HOWARD STOCKTON. DAVID R. WHITNEY.
GEORGE A. GARDNER.

Trustees of the Museum of Fine Arts.

FREDERIC W. LINCOLN. JAMES M. CRAFTS.
A. LAWRENCE ROTCH.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. ELIOT C. CLARKE.
CHARLES F. CHOATE. DESMOND FITZGERALD.
JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
DESMOND FITZGERALD. JAMES P. TOLMAN.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. DESMOND FITZGERALD.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. HOWARD A. CARSON.
HOWARD STOCKTON. WILLIAM L. PUTNAM.

Departments of Chemistry and Biology.

SAMUEL CABOT. THOMAS GAFFIELD.
FRANCIS BLAKE.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Corporation of the Massachusetts Institute of Technology:

Not long after President Walker had read to you the report of last year, he was taken from us with tragic suddenness; and you have in mind the final report of the great sum of his life's work which has been made at our memorial meeting. He has left us a house in order; and his own words in speaking to this Corporation of the sudden death of his predecessor may serve as a fitting tribute to himself: "This man whom we honored and loved, to whom we looked up as to master, teacher, father, fell, an unfinished sentence on his lips, instantly dead in our midst. At the time, in the act, it seemed to every spectator a tragedy replete with all the elements of terror and of grief; yet to me, at least, even before that stately and beloved form was laid in the grave, the whole character and bearing of the event had undergone a transformation. I saw that only a scaffolding had fallen, revealing to the view the sublime perfection of a truly finished life."

During the last year death has taken four members from the Corporation, Henry L. Pierce, Lewis William Tappan, Jr., Henry D. Hyde, and William H. Forbes.

Mr. Pierce was a member of the Committee on the Society of Arts from 1885 to 1891, and of the Committee on Literature, History, and Political Economy from 1885 to 1894. Resolutions commemorative of his character and services stand upon our records. His good-will towards this Institute was shown by the part which he took in our councils during the engrossing cares of a very busy and useful private and public life, and also by large donations. At his death the Institute became the recipient, together with Harvard College and three other public institutions, of his residuary estate,

beside a legacy of fifty thousand dollars. This bequest was without restrictions as to use, and the estate under skilful management has proved so large that the general fund bearing interest for the unrestricted use of the school will be doubled.

Mr Tappan was at first Bursar of the Institute, and upon Mr. Cummings' resignation he became Treasurer. He held during a part of this time the office of Secretary of the Corporation. In 1891 he retired from the office of Secretary; and General Walker, in expressing the regret of the Corporation, says that he had acquired in the several offices filled by him an intimate knowledge of the school, its history, organization, traditions, methods, such as is possessed by no other member of the Corporation. This knowledge of our requirements, together with his zeal and devotedness, made him a most valuable, as he was an indefatigable, aid in advancing the interests of the school.

Col. William Hathaway Forbes became a member of the Corporation in 1893 after the resignation of his father, our early, constant, and liberal benefactor, and long a member of this body. Colonel Forbes' interest in the school was promoted not only by family associations, but also by his own intimate connection with one of the most successful enterprises for the application of science to industry, the Bell Telephone Company. He was also, by his tastes for yachting, well qualified to advise with the department of naval architecture, which was founded during his first year of service on our Corporation.

Failing health has compelled the resignation from the Executive Committee of Mr. John Cummings, who for thirty-four years has served and befriended us with enthusiastic devotion, upon the Executive Committee and as Treasure · he has given us a large measure of his time and thoughts, and the resolutions passed by this body testify that at the moment of our greatest need he pledged his personal credit to support that of the school. Mr. Cummings stands foremost

among the men who have founded and sustained this Institute during its trial years.

While giving an account of the events of the school year since I assumed the duties of Chairman of the Faculty, January 13, 1897, and those of the Presidency, October 20, 1897, it is fitting to say that a new task has been rendered as little burdensome as possible by the custom of the institution, since its foundation, to entrust many questions of regulation of studies and of policy to the initiative of the Faculty. The members of different sections have always taken a leading part in shaping the growth of their departments, and a habit of hearty coöperation has grown up, which has stood us in good stead in our present emergency.

The maintenance of the total number of students may be considered as a proof of the confidence of the public in the permanent character of our institution.

The entering class is this year 318. In the three preceding years the first-year classes were 332; 320; 320.

The proportion of students who are candidates for a degree has tended to increase slightly during the last few years, and after the elimination during the first year of those who are not qualified to remain in regular standing, the classes of the succeeding years maintain their strength, losing some of their members and recruiting others from the ranks of special students and from other colleges.

The first year is avowedly a trial year, and we have been encouraged by past experience to maintain our policy of examination requirements, which do not exclude pupils from many of the less well-equipped high schools. Young men of good capacity and industry, who have not had the advantage of the best preparatory training, are often fitted during this year to take equal rank with more fortunate comrades, and native ability and the new habits of study acquired may lead them to the foremost places. It may be added that the test of adaptability to the methods of study peculiar to

scientific training sometimes reverses during the first term the verdict of entrance examinations. The methods of the scientific school are often different from those of the preparatory school, and a clever student who has succeeded in his early studies may not have the turn of mind which leads to success in science. The difference between a scholar and an observer is sometimes an insurmountable difference of mental qualities. The quality and quantity of work to be done are continually under revision by the Faculty. The standard of work leading to a degree is fixed by what we deem fair exertion for an intelligent and industrious student. On the one hand we wish in the interest of our graduates to maintain the highest possible value of the diploma, and on the other we seek to bring the requirements within the capacity of the largest number. It is well understood that no one is obliged to overtax his powers in a race for a degree in the regular four-years courses. The same end may be attained in a five-years course, and those who for any reason do not wish to pursue the regular studies can obtain in special courses the kind of education which they elect, under the careful supervision of the Faculty.

Better preparation is continually offering us a more advanced starting point, and progress in scientific methods in some instances is tending to shorten study hours, so that we may hope to raise the standard for our diploma without increasing the amount of work done in the school. The earnest solicitude of the whole instructing staff is directed towards improving the quality of the work.

The crowded condition of our laboratories and drawing-rooms makes it difficult for us to offer to students the inducements we could wish to remain and take the Master's degree. The number last year, eleven, was equal to the total of the three preceding years; and it is to be hoped that this very small beginning marks a movement in the right direction. Great influence is exerted upon his comrades by a student, who has acquired a love for science, who,

before entering upon professional work, gives himself a respite of a year or two to work out under the direction of a professor some more abstruse problems of theory or of practice. Such a man becomes a valuable auxiliary to the teaching force of the school, and the presence of large numbers of graduate students in some of our universities has contributed more than anything else to raise the character of their instruction toward the level of the older institutions of Europe.

These are some of the considerations which have guided us in dealing with educational problems, and they may serve as a preface to the description of the progress which we have made thus far in our methods of instruction.

Each year's report brings new demands for increased space. The drawing-rooms for civil engineering have one-half more students than ever before. The mechanical engineering rooms are overfilled with machinery, and too large a number of students are detailed to each machine. The chemical laboratories are filled to their utmost capacity. The mining department has a new class much larger than ever before. Important researches in biology are postponed for want of space. In other words, without any increase in the total number of students, the growing laboratory requirements of the upper classes make our accomodations each year less adequate. Our teaching continually advances in the direction of a greater subdivision of classes. The work is done under the supervision of instructors by small sections, whose principal business it is to make laboratory experiments, to test machinery at work, or to make drawings representing projects of construction in engineering or architecture. It is in this direction of subdivision and minute supervision that we are seeking to improve the quality of our work, and for this reason more teachers and larger space have to be provided for a given number of students.

I desire also to present to your consideration a new feature of these embarrassing evidences of prosperity, that is, the

probable fluctuations of the demands. The thirteen courses have been successively instituted to correspond with the new fields which science has opened to the arts, and to the demands which new industries are making upon science; and the changes in the numbers of students who are taking different courses are the measure of the popular conception of these demands for skill in some particular branch of technology. To a considerable extent these requirements are rightly understood. They are often guided by the inquiries for suitable assistants from men who have made places for themselves in the industrial world, and who are opening new positions to younger men. We cannot tell whether the success of American engineers in South African mines is one of the threads which draw a number of mining students to a Boston school. We cannot take up such a question from a commercial standpoint; but we do know that such varying demands will be made upon an industrial school, and until we have greatly enlarged our buildings, we shall be put each year to temporary expedients to meet yearly exigencies, and the Treasurer will inform you that such changes involve large expenses.

It will be long before we can hope to leave behind us the anxieties of such problems, and it should be said, moreover, that, although the condition described has often been one of great discomfort, it has never been allowed to impair the efficiency of the school. We are less favored than many neighboring institutions in building-space, but we have always followed the wise policy of keeping in the foremost rank, and in some departments leading the way in supplying the best models and apparatus for teaching and for making investigation. We have run in debt to buy them, and then run still further in debt to build houses to hold them, but we have always had them when the head of a department told the government of the school that they were necessary to the most effective teaching of his science. We now find ourselves working elbow to elbow, with the best tools, but with no room to spare, and with no margin of space to meet

change of demands. Perhaps this state of things, like the discomfort of a crowded theatre, has contributed to keep alive enthusiasm; it certainly has made evident that we were not misapplying the funds so nobly contributed for the support of the school. Each dollar at interest, or invested in land or buildings, has had its educational value, and these things were the best witnesses which we could bring before the Legislature to justify a generous grant of public money — twenty-five thousand dollars per annum donated to us for six years in January, 1895.

During next year, legacies, which do not yet appear as paid in the Treasurer's account, will allow us to put up in the spring the new building described in much detail in General Walker's report of last year, and the only shadow upon our great satisfaction is the thought that he could not live to see realized what he speaks of as "the pleasant dream in which the Executive Committee and Faculty indulged themselves until rudely awakened by the impossibility of securing the necessary funds under the painful industrial and commercial conditions prevailing the past season."

Legacies and Gifts. — The payment of the Pierce bequest will not take place until the first of next year, but we have had a large accession to our funds during the current year. Fifty thousand dollars has been allotted to our Institute by the trustees of the John W. and Belinda L. Randall Charities Corporation, with the condition that the sum shall be set apart and used in a manner commemorative of John W. and Belinda L. Randall. This legacy is a portion of a sum of $350,000 placed in the hands of the trustees to be donated for charitable and educational purposes, and the donation allotted to the Institute is most gratefully received. The trustees have in this substantial manner recognized our claims as an educational institution worthy of many-sided support.

Mrs. William B. Rogers has continued her welcome contribution to our library fund, presenting us with two hundred

dollars for the purchase of periodicals. Other friends of the Institute have contributed a total sum of nine hundred and twenty-five dollars for various purposes.

The Libraries.

The total number of accessions is 3,743. Of these, 1,229 were obtained by purchase, 916 by binding periodicals and books received in parts, and 1,598 by gift. Deducting from the total accessions books counted twice, and books removed from the shelves or lost, the total net additions are found to be 2,974 volumes, 533 pamphlets, and 126 maps, making the grand total 3,633. The following table shows the net accessions in each of the libraries of the Institute and the amount expended for the same by the departments, together with the total contents of each on Sept. 30, 1897. To a certain extent the pamphlets are counted twice, for according to the custom established in previous reports a collection of pamphlets bound together in one volume is counted as one in the list of volumes, and at the same time each pamphlet is counted as one in the list of pamphlets. Until the end of the period covered by this report the Libraries of Military Science, Mathematics, and Modern Languages were regarded as part of the General Library, although the books have been kept in separate rooms. Hereafter they will be treated as distinct libraries, and this change is the cause of certain irregularities which will be noticed in the following table:

TABLE OF NET ACCESSIONS, 1896-97, SHOWING COST OF SAME, AND TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1897.

LIBRARIES.	NET ACCESSIONS.				TOTAL CONTENTS.	
	Volumes.	Pamphlets.	Maps.	Cost Department.	Volumes.	Pamphlets and Maps.
Engineering (C.E., M.E., & N.A.)	611	105	93	$982.53	7,282	3,319
Mining	217	20	..	240.52	1,903	323
Architecture	151	4	..	520 19	2,030	185
Chemistry	391	40	..	509.03	6,956	1,477
Biology	148	23	..	226.23	1,950	374
Physics	311	13	..	701.99	5,696	669
Political Science. (Econ. Hist.)	587	66	..	491.65	8,560	3,941
English	80	..	..	145.00	2,273	30
Military Science	..	..	..	...	98	....
Geology	98	11	33	90.68	1,705	805
Mathematics	..	..	..	...	540	113
Modern Languages	..	..	..	..	505	....
General Library	347[1]	251[1]	..	259.25[1]	3,798[2]	3,250[2]
Margaret Cheney Room	24	..	..	..	599	15
Totals	2,974	533	126	$4,182.07	44,015	13,605

[1] Including Military Science, Mathematics, and Modern Languages.
[2] After deducting Military Science, Mathematics, and Modern Languages.

From this table it will be seen that the libraries of the Institute contained at the end of the fiscal year, in all, 44,015 volumes and 13,605 pamphlets and maps.

The periodicals regularly received form one of the most valuable features in the yearly increase of the libraries. The following table shows the number and probable cost of the publications of this kind which are received regularly, including such official reports as are listed in the published catalogue of periodicals received in the libraries of Boston:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS, 1896–97, SHOWING THE NUMBER AND ESTIMATED COST OF THOSE RECEIVED FOR EACH DEPARTMENT, AND OF THOSE CHARGED TO EACH ACCOUNT.

LIBRARIES.	NUMBER RECEIVED.					ESTIMATED COST.			
			Periodical Account.				Periodical Account.		Totals.
	Gifts.	Dept. Acct.	T.Q.	Subs.	Totals.	Dept. Acct.	T.Q.	Subs.	
Engineering (C.E., M.E., & N.A.)	51	14	64	44	173	$42.41	$153.60	$185.58	$381.59
Mining	12	1	20	22	55	1.79	48.00	76.91	126.70
Architecture	3	....	4	24	31	....	9.60	139.78	149.38
Chemistry	88	10	14	42	154	36.81	33.60	108.95	179.36
Biology	23	6	7	29	65	21.10	16.80	183.29	221.19
Physics	12	1	28	28	69	.85	67.20	135.81	203.86
Political Science (Econ. & Hist.)	55	24	6	74	159	49.91	14.40	212.09	276.40
English	....	....	....	8	8	....	....	27.09	27.09
Military Science	2	....	....	2	4	....	....	3.50	3.50
Geology	19	1	9	6	35	....	21.60	29.95	51.55
Mathematics	1	....	2	13	16	....	4.80	46.45	51.25
Modern Languages	....	1	1	2	4	6.00	2.40	9.60	18.00
General Library	44	....	14	12	70	....	33.60	26.90	60.50
Lowell School of Design	....	....	....	4	4	....	....	11.25	11.25
							$405.60	$1,107.15 405 60	
Totals	310	58	169	310	847	$158.87		$1,602.75	$1,761.62

The periodical account is charged with the periodicals received in exchange for the Technology Quarterly, as well as with those for which cash subscriptions are paid. For each copy of the Technology Quarterly sent in exchange for the periodicals the Society of Arts is credited with $2.40 annually, the wholesale price, and the Periodical Account is charged with a like sum, as indicated in the columns "T.Q." in the foregoing table. The table shows that 847 periodicals and other serial publications are received regularly, besides a large number of official reports that have not been counted.

The expenditures for the year on account of the libraries, exclusive of salaries, may be summarized as follows:

Paid by departments for books and binding,		$4,182.07
Periodical account, subscriptions . . .	$1,227.78	
Technology Quarterly for exchanges . . .	476.80	
		1,704.58
Expense account, libraries		218.81
Total		$6,105.46

There were sent out during the year 1,246 orders for new books. One hundred and twenty-one duplicate orders were returned to heads of departments, and of these only 23 were reordered. For binding and lettering there were given 1,014 separate orders amounting to 1,484 volumes, costing in the aggregate about $1,285.68. There were added to the main catalogue 2,416 cards, but in the process of uniting several lists heretofore kept separate, 175 duplicate cards were removed. The total number of cards in the main catalogue is now 39,673. We have received for inspection 253 foreign books, of which 100 were purchased. From the Chemical Library 1,893 books were borrowed for home use. Records were not kept in the other libraries, but the indications are that they were used fully as much as this one.

Of the 1,598 volumes and pamphlets received as gifts, the following books are especially worthy of notice: From Mrs. Henry Draper, of New York, parts of Stegmann's Architektur der Renaissance in Toscana; Robida, Le Cœur de Paris; Harper's Pictorial History of the Rebellion; Piranesi, Della magnificenza e d'architettura de' Romani, 1761; Piranesi, Le antichità Romane; the second volume of Sachs' Modern Opera Houses and Theatres; and Comptes Rendus de l'Academie des Sciences de Paris; from His Highness the Maharaja of Jeypore, six volumes of the beautiful Jeypore portfolio of architectural details; from Mrs. William B. Rogers, 8 copies of her Life and Letters of William Barton Rogers, and 42 volumes, chiefly from the library of her father, Hon. James Savage; from Prof. Charles Sedgwick Minot, 20 volumes on engineering subjects; from W. O.

Ross, Esq., 32 volumes, chiefly on physics; from Miss Julia Delano, of New Bedford, 6 volumes on the early history of the steam-engine. Professor Bates, Professor Talbot, Professor Gill, and Dr. Whitney have presented the Institute with copies of their published writings.

Changes in the Faculty and the Corps of Instruction.

Assistant Prof. Arthur A. Noyes, S.B., Ph.D., has been promoted to be Associate Professor of Organic Chemistry.

The Faculty has been reënforced by the following promotions from the corps of instructors: namely, Harry M. Goodwin, S.B., Ph.D., to be Assistant Professor of Physics; Frank A. Laws, S.B., to be Assistant Professor of Electrical Measurements; John O. Sumner, A.B., to be Assistant Professor of History.

Dr. Noyes graduated at the Institute in 1886; continuing his studies for an additional year, he obtained the degree of Master of Science, and became an Assistant in Analytical Chemistry. In 1888 he went to Europe and studied under Ostwald at Leipsic, obtaining his doctorate in 1890. Returning to the Institute in that year, he was appointed Instructor in Analytical Chemistry. The following year he was transferred to the department of Organic Chemistry, where he has served the Institute with distinguished success. In 1894 he was appointed Assistant Professor of Organic Chemistry. The reports of the successive years since his graduation contain the titles of a very interesting series of papers on physico-chemical subjects which he has studied with unwearying industry and success.

Mr. Laws graduated from the Course in Electrical Engineering at the Institute in 1889, and began his duties as Assistant in the Physical Laboratory in the following autumn. His work gradually came to be directed more especially toward electrical testing, in which he showed marked ability. In 1891 he received the appointment of Instructor in Physics,

and in 1894 that of Instructor in Electrical Measurements. Upon the withdrawal of Professor Holman from active participation in the work of the electrical laboratory the immediate care of the instruction in electrical testing devolved upon Mr. Laws, who also assumed the course of lectures upon electrical measuring instruments and methods. These courses have been greatly extended under his direction.

Mr. Laws has published a number of original papers relating to electrical instruments and testing, and the magnetic properties of iron, in the Proceedings of the American Academy, the Technology Quarterly, and elsewhere. He is at present engaged in the preparation of a set of notes on electrical measuring instruments, which, when completed, will fill a gap in this field and be of great service to our students, for whom they are especially designed.

Dr. Goodwin graduated from the Course in Physics at the Institute in 1890, and was appointed Assistant in Physics at that time. In 1892 he received the appointment of Instructor in Physics, and was then granted leave of absence in order that he might prosecute his studies in Germany. He remained there for two years, devoting himself especially to the study of physical chemistry at Leipsic with Professor Ostwald, and was awarded the degree of Ph.D. with the highest honors. On his return at the beginning of the school-year 1894–5 he took charge of the instruction in general physical measurement. Through his efforts this course has been much strengthened. The laboratory of physical chemistry was also established at his instance, and the entire course of instruction in this new and important branch has been planned and carried out by him.

Dr. Goodwin has made various original researches, especially upon physico-chemical subjects, which have been published chiefly in the Zeitschrift für Physikalische Chemie, the Physical Review, and the Technology Quarterly.

Mr. Sumner graduated at Harvard College in the class of 1887. He spent five years in European study and travel,

devoting himself chiefly to mediæval history, literature, and art. The report of 1894 makes mention of Professor Sumner's courses of instruction in the political history of the United States and of England, and the history and literature of the Renaissance and Reformation. The department of architecture has hitherto depended upon outside lecturers for the treatment of the history of painting and sculpture. This instruction is now in the charge of Professor Sumner, and has gained in regularity and importance. He collected, during last summer, in Europe, an excellent series of photographs and slides; these, together with slides prepared by Professor Lawrence, have been used with excellent effect to illustrate the lectures.

Professor Holman's ill health has withdrawn him from active work, although not from participation by his counsels in our plans for the best interests of the school. He has been appointed Professor of Physics Emeritus.

Professor Silas W. Holman graduated from the Institute in 1876, and was immediately thereupon appointed Assistant in the Physical Laboratory, but on account of illness he did not begin his actual duties until a year later. In 1880 he was advanced to the grade of Instructor; in 1882 he received the appointment of Assistant Professor; in 1885 that of Associate Professor, and in 1893 that of Professor of Physics. He has thus been connected with the Institute as a member of its staff of instruction for twenty-one years.

During the whole of his active service Professor Holman has devoted himself most earnestly to the building up of the work of the Physical Laboratory, and in later years more especially to the work in electrical and heat measurements. From the beginning he showed a rare capacity for accurate physical work, and a healthy intolerance of any other than such work on the part of a student. To this was coupled a fine appreciation of the relative value of different methods of solving a physical problem, high experimental skill in carrying out a physical research, and much inventiveness in the

adaptation of special methods to general laboratory use. These qualities, with his steady faithfulness to the highest interests of the Institute, have made his influence of such a character that it cannot be too highly estimated.

Professor Holman's publications all give evidence of the characteristics which have been referred to. The Physical Laboratory Notes printed by the Institute for the use of its students, and especially the part devoted to electrical measurements, stand far apart from other publications of like character in the clear manner in which the particular adaptation of each process is set forth, and the distinct recognition of the limits within which each is applicable. Though not great in bulk, they embody the results of years of teaching, and the experiments are so well selected and arranged that a student gains infinitely more by the performance of a limited number of them, with the scrupulous care which they require of him, than by a much more widely extended course of less carefully planned exercises. Like good judgment and skill in arrangement are found in the volume on "Precision of Measurements," written by him for use of our students, and in a recently published collection of Logarithmic Tables, which has received high commendation both in this country and abroad.

Professor Holman had much skill in research, either when conducted by himself personally or by others under his direction. His thesis at graduation was published, and was immediately recognized as a paper of exceptional merit upon a difficult subject, the Viscosity of Gases. Other papers upon the same subject were published in subsequent years, and are of standard authority. To these he added researches of value upon thermometry, thermo-electricity, and electrical measurement, many of which were laid out as thesis subjects for advanced students in Physics and Electrical Engineering, and carried on under his direction, the last of them even after failing strength had compelled him to abandon the attempt at personal supervision of the experimentation.

From the time of his graduation Professor Holman had been hampered by a lack of robust health, and in later years a more serious impairment became manifest. A year's leave of absence, while helpful, served only to retard the progress of disease, so that he has been obliged gradually to relinquish his duties, and for the past two years has been unable to be present in the laboratory, though still ready to render valuable aid to his colleagues by suggestion and advice.

Professor Currier has been prevented by illness from taking his classes this term, and we miss his devoted services. It is hoped that he will be able to renew them next term. The work has been carried on without interruption, and we have fortunately been able to obtain a course of lectures on Comparative Politics from Professor Macvane, Professor of Ancient and Modern History in Harvard University.

Professor Bates is giving a course of lectures at Harvard University to supply the place of Professor A. S. Hill, now absent. This is not the first time that an interchange of services has taken place between the two institutions, and has proved of great convenience.

Mr. Charles T. Wentworth, A.M., has been appointed Instructor, and is now giving the course of lectures on European History to the second-year class. He was formerly a student of the Institute in Mining Engineering, and has since devoted himself to historical studies at the University of Wisconsin and at Harvard.

Mr. Henry M. Howe, A.M., S.B., Lecturer on Metallurgy, and a high authority on that subject, has accepted a call to the chair of Metallurgy at Columbia University. The good work he did with us for some ten years will be much missed, and the university to which he has gone is to be congratulated upon its acquisition of a professor who is at once so well informed a scholar and has so thorough a practical acquaintance with his special work.

Mr. Harry C. Bradley, S.B., of the class of '91, has been appointed Instructor in Mechanical Drawing and Descriptive Geometry.

The following Assistants of last year in the several departments named have been appointed Instructors: Carl H. Clark, S.B., '95, and Frederick A. Hannah, S.B., '95, in Mechanical Engineering; Charles M. Spofford, S.B., '93, in Civil Engineering.

The following Instructors have terminated their connection with the Institute: George W. Hamblet, on account of the demands of private business; G. Russell Lincoln, for travel and study in Europe; F. H. Robbins, to enter the employ of the Boston Water Board.

The following-named Assistants have been appointed for the current year:

Frederick L. Edmands, S.B., '97, in Mechanical Drawing; Myron L. Fuller, S.B., '96, in Geology; Charles N. Haskins, S.B., '97, and Nathan Hayward, S.B., '97, in Physics; George L. Hosmer and Francis H. Watts, S.B., '97, in Civil Engineering; Elbridge C. Jacobs, S.B., '97, in Mining Engineering; Walter B. Russell, S.B., '97, and James W. Smith, S.B., '97, in Mechanical Engineering; Robert G. Valentine, A.B., in English; Alpheus G. Woodman, S.B., '97, in Sanitary Chemistry; Lewis P. Chapin, Ch.E., in General Chemistry; William F. Hyde, in Forging; Herman W. Marshall, S.B., '97, and Percy G. Stiles, S.B., '97, in Biology.

Statistics of the Corps of Instructors.

The Catalogue of 1897–98 shows the number of instructors of all grades to be 132, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 158. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1896–97.	1897–98.
Professors	23	23
Associate Professors	7	8
Assistant Professors	21	23
Instructors	52	53
Assistants	24	25
Lecturers	26	26
Total	153	158

Scholarships.

As stated in the last Report, the scholarship resources of the Institute have been much increased by recent State legislation and by the bequest of Mrs. Ann White Vose. The available income at present amounts to more than $14,000, of which $8,000 is for State scholarships. In spite of this increase, the necessities of applicants on account of the general financial depression have fully kept pace with the increased income. The number of applicants for Institute scholarships for the present year has been 114, while 113 submitted applications for the forty State scholarships. Fifty-seven of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 170. Of these 31 have received scholarships to the amount of full tuition; 79 others have received smaller amounts, averaging somewhat more than one hundred dollars each. The Treasurer receives returns to some extent from former beneficiaries of the Rogers Fund, but it does not appear that repayment is made to the full extent that it should be under the terms of the agreement.

The Students' Coöperative Society has taken this year a larger development than ever before. This society has not been mentioned in former reports, and it deserves a short notice. A body of students have organized themselves for administrative purposes with the kindly intent of facilitating the purchase of books, supplies, etc., within the buildings. Considerable time and attention has been given by the officers to making contracts, purchases, and sales. During vaca-

tion preparations were made to have the requisite stock of materials on hand at the beginning of the term.

Two supply rooms have been conducted by the society, one in the Architectural Building and the other in the Engineering Building, both open daily during the term. Up to November 30 the total receipts of the society had amounted to $2,890.42, and it is estimated that the business for the year will exceed $5,000. It need scarcely be said that these arduous services are performed without remuneration by officers of the society, and that the incidental expenses for services are thus kept as low as possible. The society has been enabled to assist the scholarship committee of the Faculty this year to the extent of $650. But for this welcome aid a number of deserving students would have been unable to continue their work at the Institute.

The Y.M.C.A. Association.

The work of students belonging to this association, which was described in the last report, has been carried on with renewed energy this year. Fifteen hundred handbooks have been issued, so that each new student, or any one expecting to come to the Institute, is supplied with a guide to the headquarters of the association, where he can obtain directions regarding lodging places, as well as information regarding school work, tabular views, recitations, etc. About one hundred students have been directed to lodgings, and care has been exercised in making enquiries about the houses which were recommended, and in keeping informed about them. The annual reception to the new class gave an opportunity for a first general social meeting. Professor Niles made an address. The club-house which is occupied as headquarters and living rooms by the association has been successfully maintained. The house at 466 Massachusetts Avenue is open to the students, and monthly meetings are held there.

Entrance Requirements.

In his annual reports for 1894 and 1896 President Walker treated at considerable length the question of higher requirements for entrance, and gave strong reasons why no tasks should be imposed which should tend to raise the average of the age at which students are prepared to enter this school — at present nearly nineteen years. He thought that the high schools should be so equipped and officered as to give the necessary instruction within that limit of age. Our catalogue for this year announces the requirement, for 1898 and after, of one additional subject, which may be elected from among the following: Elementary Latin, Physics, Chemistry, Mechanical Drawing and Shopwork, additional French or German, English or History. It is hoped that the students will come to us with this added study completed within the above average limit of age. The question of additional requirements has been for a long time discussed by the Faculty, and the present requirement is expected to lead to various results of much interest.

On the one hand it emphasizes effectively the position long held by the Faculty, that no preparation is adequate which merely enables the candidate to pass the prescribed examinations. On the other hand, since it is not intended to hold examinations in the elective subjects, we are enabled to try an interesting experiment in regard to the use of teachers' certificates. The substitution of certificates for entrance examinations has been very extensively — and in some cases very successfully — employed. At this Institute, and in many other institutions of New England, examinations have been required to the entire exclusion of admission by certificate. The acceptance, in addition to our tests by examination, of teachers' certificates for elective subjects will give the secondary teachers a not unwelcome share in determining the eligibility of candidates, and will not, on the other hand, involve the risks incident to the unqualified adoption of the certificate system.

A series of questions in regard to entrance requirements, issued last year by a committee of the Massachusetts Association of Classical and High School Teachers, offered a welcome opportunity to define our position in regard to entrance requirements. A reply was prepared by a committee and submitted to the Faculty, and after very careful examination was approved and printed. A statement of certain principles determining the attitude and policy of the Institute was added, and the paper was distributed among secondary schools having relations with the Institute. Some of the main points of the statement were as follows:

1st. That it was not the intention of the Institute to make any such change in its requirements as should essentially enlarge the total amount of work of the secondary schools, or in any way to place its requirements above the range of work done by the public high schools.

2d. That the Institute is ready, as heretofore, to coöperate in any practicable plan for securing such a degree of uniformity in the requirements of colleges generally as is consistent with other important interests.

3d. That the object of the entrance requirements of the Institute is the best practicable discrimination between fit and unfit applicants for admission, and not the reconstruction of the secondary school curriculum.

4th. That any material increase in the present average age of entrance would be a serious misfortune.

5th. That it is for the best interest of secondary schools generally that requirements should be within the reach of their four-years courses, even if it is thereby rendered possible for individual applicants from particular schools, by narrowing their courses, to meet the requirements in three years, instead of four.

The reply of the Faculty was cordially received by the Association, and is believed to have commended itself to a large proportion of those most interested.

Another valuable opportunity for promoting closer rela-

tions between the Institute and secondary schools occurred somewhat later in the spring. The statement of our new requirements was presented, for suggestions and criticism, to some twenty representative secondary school teachers, mainly of eastern Massachusetts, and an informal conference with a committee of the Faculty was held at the rooms of the Technology Club. The interest shown, the nearly complete attendance of teachers invited, and the time given by them to thorough discussion of the numerous and important questions raised, were exceedingly gratifying. Important modifications were made in the report of the committee, which has now been adopted by the Faculty and incorporated in the Catalogue for the current year. It is hoped that future conferences of this kind may be held with equal success.

Summer Schools.

Geodesy, Topography, and Hydraulic Engineering. — The summer school for field work in geodesy, topography, and hydraulics was held during the month of June at Machias, Me., the same place where the school of last year was held. This was the ninth summer school of the Civil Engineering Department. It is an optional course, open to the third-year students in Civil Engineering, enabling them to get valuable practice which they would not otherwise obtain. Eight students were in attendance this year, a smaller number than usual, but the weather was favorable, and the amount of work accomplished was larger than in the year previous. Instruction was given by Professors Burton, Porter, and Robbins, assisted by Mr. Henry E. Warren, a graduate of the Institute in the class of '94, and Mr. George L. Hosmer, of the class of '97.

The work, as usual, consisted mainly of field work during a period of about three weeks. Some very interesting experiments were made in connection with the use of the thermophone in determining the coefficient of expansion of the 100 meter steel tape used in base-line measurements.

These experiments were carried on under the direction of Mr. Warren, one of the inventors of the thermophone, and the results will be published in some future number of the Technology Quarterly.

Several of the old Coast Survey stations were reoccupied, signals were erected, and practice was given in measuring and adjusting the angles in a scheme of triangulation. Plane table surveys were made of the adjoining country, and three different scales were used by different parties in order to illustrate the varying methods of work necessitated by changes in the scale of the map. Thus a nine-mile road traverse was made with sketching plane table on a scale of 1 to 30,000; a square mile of territory was mapped on a scale of 1 to 5,000, using contours ten feet apart; and a map of the mills and of the Machias river in the immediate vicinity of the town was made on a scale of 1 to 1,000.

At Howard Bay, on the sea coast, a tide gauge was set up and tidal observations were taken throughout the entire term of the school. The actual tide curves were plotted, and were compared with the computed tides given in the Coast Survey Tables.

Soundings were taken and located by sextant angles, and the soundings were plotted on a plane table survey of Howard Cove on a scale of 400 feet to an inch.

Meteorological observations were made throughout the three weeks, and were recorded in forms issued by the Weather Bureau. Practice was also given to the students in working many of the problems of practical astronomy with the sextant and engineer's transit.

The hydraulic work was essentially the same as last year, and for this reference may be made to the last annual report.

Metallurgy. — The summer school of metallurgy was this year held in the States of New York and Ohio. Visits to mines and to furnaces occur on alternate years; this was the year for furnaces. The party consisted of Professor

Hofman and seven students from the second, third, and fourth year classes of the Department of Mining Engineering, and Metallurgy. The first stop was at Syracuse, N.Y., at which point visits were made to the coke works of the Solvay Process Company, the State Union Salt Works, the Onondaga Pottery Company, the New York Paving Company, and to Church & Co., soda packers. The next stop was at Buffalo, and visits were made to the Buffalo Smelting Company, the Tonawanda Iron and Steel Company, the Buffalo Furnace Company, the Pratt & Letchworth Company, and the Atlas Works of the Standard Oil Company. The party next moved on to Niagara Falls, where they visited the works of the Carborundum Company and the Power Company. At Cleveland visits were made to the Otis Steel Company, the Cleveland Ore Docks, the Union Rolling Mill Company, the United Salt Company, the Brown Hoisting and Conveying Company, and shipyard of the Globe Iron Works. At Lorain the Johnson Company was visited. The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest that was taken in the students, to whom the freedom of the works was granted.

Architecture. — The Summer School in Architecture for this year was held in Quebec. Mr. Gardner, with a small party of students, spent three weeks in the town and its suburbs. It was the aim of the school to give the students practice in out-of-door sketching in pencil and water color, in preparation for a future European trip. The old town, with its historical interests, its curious people and customs, its attractive and picturesque bits of simple architecture, proved to be almost as good as a European city itself for such work.

Summer Courses.

The following volunteer courses were given to the number of students indicated. In many cases the instructors, with great self-devotion, gave their courses to a number of students too small to offer adequate remuneration, in several instances to a single student, not wishing to disappoint those who were seeking their instruction:

Programme of Summer Courses.

I. Mechanical Drawing and Descriptive Geometry. 32. (Prof. Faunce.)

II. Mathematics: Analytic Geometry. 9. (Mr. Pascano.)

III. Architecture. (*a*) Shades and Shadows. (*b*) Elementary Design. 9. (Mr. Gardner.)

IV. Chemistry. (*a*) Analytical Chemistry. 27. (Dr. Walker.) (*b*) Organic Analysis, Reactions, and Preparations. (*c*) Principles of Organic Chemistry. 10. (Dr. Mulliken.) (*d*) Water Analysis, and Air Analysis. 1. (Mrs. Richards.)

V. Biology. (*a*) General Zoölogy. 2. (*b*) Bacteriology and the Micro-Organisms of Fermentation. 1. (Mr. Prescott.)

VI. Physics. (*a*) Mechanics, Light, and Electricity. 6. (Mr. Drisko.) (*b*) Heat. 7. (Prof. Clifford.) (*c*) Physical Measurements. 10. (Dr. Goodwin.) (*d*) Electrical Testing. 9. (Mr. Laws.)

VII. Modern Languages. (*a*) French. 12. (Mr. L. Bernard.) (*b*) German. 16. (Prof. Vogel.)

VIII. Mechanism. 4. (Prof. Merrill.)

IX. Shopwork. (*a*) Carpentry and Wood Turning. 8. (*b*) Chipping and Filing. 20. (*c*) Machine Toolwork. 20. (Mr. R. H. Smith.) (*d*) Forging. 7. (Mr. Lambirth.)

Summer Reading.

During the past year the Faculty, in accordance with its established policy of requiring that adequate attention be given by all Institute students to studies of a non-professional character, has voted to supplement the instruction now given in such subjects by the introduction of courses of required reading to be done in the summer vacation, following the first and the second school years.

On account of the very large portion of the student's time which in a technical school is necessarily occupied by his purely professional studies, it is difficult to introduce into the course as large an amount of instruction in literature, history, and general science as would be desirable. And it is believed that the plan of requiring summer reading in general literature is the only feasible one by which the difficulty can be overcome. In the preparation of the list of books, great care was used to select only those which are readable and attractive in character, as well as instructive, in order not to make the requirement an onerous one; for it was thought even more important to awaken interest in reading than to impart information. As far as can be judged at present, the plan has worked satisfactorily during the past summer.

Military Science and Tactics.

This service, under the care of Captain Bigelow, has made continued progress, and besides its evident educational usefulness for citizens who may be called out as soldiers, it has acquired a distinct value as an element of general culture. Unfortunately too large a share of the history of nations is the story of their military exploits, and we must recognize that some knowledge of military science which leads to a better estimate of the genius of commanders and the endurance of armies will fit a student to be a more intelligent reader of history.

In the month of April an optional course in Military Engineering was given for students of Civil Engineering. The time allowed for it was six hours, allotted to class-room work, and a half-day for field-work. Of the former, five hours were given to lectures, and one to the solution of a problem in field fortification on a map. The field-work consisted in the tracing and defilading of a line of parapet and the digging of sections of shelter trenches at the Watertown Arsenal. The attendance on this course numbered 26, which was

more than that of any former year. The success of the work in military engineering during the past two years is due in a large measure to the courtesy of Maj. J. W. Reilly, Ordnance Department, U.S. Army, commanding Watertown Arsenal, who has not only allowed the students the freedom of the grounds, but furnished them the tools for excavation, and material to be expended, and labor to assist them, in the work which they undertook.

At the commencement of the present school year the usual examination was held for the selection of officers and non-commissioned officers. The attendance and the showing made by the candidates were quite satisfactory. The attendance would doubtless have been larger but for the delusion — of which a number of the students were victims — that their previous experience in military schools or organizations would exempt them from military work at the Institute. Care will be taken to warn future students against this error.

The number of students enrolled in the regular course (Course A) is 287, and in the special course (Course B), 14. The enrolment in Course B consists mainly of students who are physically unable to drill. But in both courses students were enrolled and attended the exercises who were entitled to exemption from such exercises, but engaged of their own accord to take them. The number of voluntary students, though of necessity small, was larger than ever before.

An innovation, which is regarded by Captain Bigelow as of cardinal importance and a great improvement, is the appropriation by the Executive Committee of a fixed sum for the support of the military department, to be expended by the head of the department for the following items: care of arms; heating of armory; cleaning of armory; books, maps, slides, etc.; competitive drill, etc.; sundries.

The books acquired by the department during the past three years were placed this fall in the general library, in a rack specially provided for them. They number about 120 volumes, and, together with works of a military character in

the other libraries of the Institute, may be regarded as a good foundation, or nucleus, of a military library.

Captain Bigelow concludes his report with the following words:

"On the 1st of August, 1898, I shall have completed four years of duty at the Institute, and shall, in all probability, be relieved from such duty. I cannot close this communication without expressing my appreciation of the advantages which I have enjoyed as a member of its Faculty, and my gratitude to the professors, instructors, and students for their many kindnesses and uniform courtesy and consideration. I know that I have taken from the Institute more than I have given it, but I shall always be willing to balance the account by any means at my command, and shall ever esteem my four years' tour at the Institute as one of the pleasantest and most profitable periods of my career."

Courses I. and XI., Civil and Sanitary Engineering. — Some changes have been made in the work of the fourth year, in consequence of the transfer to the third year of the course in applied mechanics.

The changes in Course I. consist in introducing in the first term a course in industrial electricity; in increasing the preparation allowed in the course in astronomy; in adding in the second term a special course in foundations (a subject previously included in the course in structures), and in extending throughout the entire term the course in machinery and motors, previously given in the last term only. The course in Civil Engineering now comprises, besides the usual courses in purely civil engineering subjects, a not inconsiderable amount of instruction in mechanical engineering; namely, the course in mechanism in the second year and the course in steam engineering which extends throughout the fourth year.

In Course XI. the changes made consist in introducing the courses in metallurgy of iron and industrial electricity, together with a short course of thirty hours in shop work, especially devoted to pipe-fitting. This course will be

especially useful to those who desire to become sanitary inspectors.

The Geodetic Laboratory, for which an appropriation was made last year, and to which reference was made in the last annual report, has not yet been erected, for the reason that upon working out the detail plans and specifications and getting bids for the work, the appropriation proved too small. An increased appropriation having been made for the present year, a location has been selected in the Middlesex Fells and permission obtained from the Metropolitan Park Commissioners for the erection of the building. It is expected that it will be ready for use early in the spring.

Mention should here be made of the publication in the Technology Quarterly of the results of Professor Burton's expedition to Greenland last year. The report of Mr. Putnam, of the U.S. Coast and Geodetic Survey, giving the results of the pendulum and magnetic measurements, constitutes an especially interesting memoir, and one whose scientific value has been shown by expressions of approval from the highest sources.

The equipment of the department has been somewhat increased during the past year. A powerful rotary pump with a capacity of 1,000 gallons per minute has been added in place of a smaller one which was worn out. A Milton Smoke Tester for testing the tightness of house drains has been purchased, together with various smaller pieces of apparatus. Emphasis should here be laid on the need of an enlargement of the reservoir used in connection with the hydraulic plant, to which reference was made in the last report. Mention may also be made of some thesis work on the loss of head attending sudden contractions in area of pipes, completing a series of experiments in this direction which have been taken up in several successive years.

Excursions have been made to Worcester, Brockton, and Moon Island, and thanks are due to President Lucius Tuttle, of the Boston & Maine Railroad; General Manager W. H. Barnes, of the Boston & Albany Railroad; Mr. F. H. Snow,

City Engineer of Brockton, and Mr. B. W. Wells, Superintendent of Streets of the City of Boston, for courtesies extended in connection with these excursions and with the general work of the course. In connection with the work in hydraulics, a lecture was given by Mr. A. V. Garratt, Chief Engineer of the Lombard Water Wheel Governor Company, on governing devices for turbines.

There is pressing demand for more room in order to carry on to the best advantage the work in civil engineering. The second and third year drawing-rooms are crowded beyond their reasonable capacity. In the second year drawing-room there are 96 students, while the greatest number which we have ever had before has been 66. It is imperative that additional space should be provided, unless the number of students in these courses is restricted. In the third year drawing-room there are 56 students. In the fourth year, there are 38 students, of whom three are in Course XI., and one takes but few studies in this year. Of the remaining 34, 20 have chosen the first or general option, and 14 the second or railroad option.

Course II., Mechanical Engineering. — Attention was called in the report of last year to the improvements in the third year work of the course consequent upon the advance of entrance requirements. Time has now been gained in the fourth year by the omission of the lectures on dynamo machinery heretofore given by Professor Cross, consequent upon the introduction among the third-year studies of the courses in industrial electricity and dynamo-electric measuring instruments and methods; and also by the transfer of Political Economy from the fourth to the third year. In consequence of the above changes, and of some other readjustments of studies, the following new or enlarged courses have been introduced:

1. SHOP MANAGEMENT. — Professor Schwamb will give a course of ten exercises on this subject in the second term of the fourth year, each exercise requiring two hours' preparation on the part of the student.

2. A course on Foundations will be given to the fourth-year students by Professor Lanza.

3. The time heretofore taken from the options for the lectures on industrial management and dynamo machinery being restored, the work of all three of the options will be correspondingly extended and improved.

4. The course in machine design has been increased by fifteen hours.

THE ENGINEERING LABORATORIES. — The number of students having assignments to regular laboratory exercises in the portions of the engineering laboratories other than the laboratory of applied mechanics was, during the school year '96–97, 239. The nature of the tests, and the number of each kind performed in the regular laboratory work, has been as follows, viz.:

Tests of the transmission of power by belting	44
Tests of the flow of steam through orifices	76
Tests of the triple expansion engine where the heat balance is made	4
Ordinary tests of the triple engine	60
Test of steam-boiler plant, 72 hours long	1
Tests of surface condensers	72
Tests of steam injectors	70
Tests of steam ejectors	70
Tests of steam pumps	52
Calorimeter tests of steam	65
Tests of 36 H.P. gas engine	70
Valve setting of plain slide valve	76
Valve setting of Meyer valve	50
Valve setting of Corliss valve	68
Tests of pulsometer	76
Tests of Pelton water wheel	84
Tests of Swain turbine	66
Tests of rotary pumps	74
Tests of hose nozzles	72
Tests of plunger pumps	76
Tests of pulley blocks	44
Tests of gauges	44
Tests of jackscrews	28
Tests of hot-air engines	76
Tests of planimeters	26
Tests of hydraulic ram	19
Total number of tests in regular work of engineering laboratories other than laboratory of applied mechanics	1,463

It may be well to add that the results of the tests are computed by the students performing them, and examined by some of the instructing staff who have previously made the computations themselves.

The difference between the old practice in mechanical engineering and the more scientific training of the modern school is the difference between guessing and testing. The guess often led to an unpleasant surprise in coal consumption at the end of the year, and the loose kind of accounting which makes manufacturing enterprises uncertain. The demand of the present day is for engineers capable of testing accurately each part in the performance of a machine.

APPLIED MECHANICS. — The number of students having assignments to regular work in the laboratory of applied mechanics in '96–97 was 182.

The nature of the tests performed, and their numbers, were as follows, viz.:

Tests of bolted joints in steel plate	8
Tests of wrought-iron pipe columns	20
Tests of crushing strength of cast-iron water-pipe from 6 in. to 48 in. in diameter	31
Tests of timber beams	44
Tests of tensile strength and elasticity of Burden-iron 2 in. in diameter	33
Tests of tensile strength and elasticity of refined iron 1 in. in diameter	16
Tests of torsional strength of compositions	12
Tests of tensile and torsional strength and elasticity of wire of wrought-iron, of steel, and of brass	174
Tests of the tensile strength of various knots and hitches in manila and hemp rope, and of the rope itself	70
Tests of tensile strength of cement and mortar	100
Tests of compressive strength of cement and mortar	100
Miscellaneous tests of iron and steel	27
Other miscellaneous tests	105
Total number of tests made in '96–97 in the regular work of the laboratory of applied mechanics	740

Since the publication of the last president's report there have been issued Nos. VI. and VII. of the "Results of Tests

made in the Engineering Laboratories," No. VI. being a reprint from the Technology Quarterly, Vol. IX., No. 4, December, 1896, and No. VII. a reprint from Vol. X., No. 3, September, 1897, the former containing the results of a number of the tests in steam and hydraulics, including a test of the plant at the Charlestown power-station of the West End Street Railway; together with several steam-boiler tests, and the latter containing the results of tests of timber trusses and headers, together with half-tones of the fractures; and also results of the tests of cast-iron water-pipe.

While the apparatus added to the engineering laboratories a year ago has proved very useful, it should be observed that the increasing demands upon these laboratories, the large amount of thesis work for which the apparatus has to be used, together with the need of constant extension to keep in touch with the outside development of practical engineering work, render it important that we should have additional apparatus. For this additional room is a necessity.

Course III., Mining and Metallurgy. — The second, third, and fourth year classes number respectively 23, 8, and 7. It has been mentioned that Mr. Howe, who has for many years been Lecturer in Metallurgy for our fourth-year students, has left us. We are fortunate in being able to commit this subject to the able teaching of Professor Hofman. In view of the increased work of the department, a new Assistant has been appointed by the Corporation.

The laboratories have been extended and the work made more efficient. The assay laboratory has been enlarged by the addition of twenty-six new desks; five new pulp-balances and four new button-balances have been added. The supply-room has been nearly doubled in storage capacity. In the ore-dressing room the rolls, the Hendy feeder, the centrifugal pumps, and the dust-fan have been thoroughly renovated and connected anew to the power so as to give them greatly increased efficiency. Of new machines that have been purchased or ordered, there may be mentioned a new Woodbury

belt vanner, a Sturtevant roll-jaw crusher, a Harz jig, and a canvas table. Other machines will be added in the near future.

Basing the estimate on the numbers that are now taking the desirable course in the first and second years, the present laboratories and instructing force are not large enough to meet the needs of the immediate future. It would seem that the whole basement of Rogers Building, or some equivalent space, should be placed at the disposal of the department.

The library has grown to such an extent that a new bookcase has been added and the whole library rearranged. Two important periodicals have had their files made up so that they are now complete from the first numbers to date; they are the "Freiberger Jahrbuch" and the "Revue Universelle des Mines." A complete set of Karsten's Archiv has been purchased. Three new periodicals have been added; namely, the "Iron Trade Review," the "South African Mining Journal," and the "Journal of the American Foundrymen's Association." Arrangements are being made for obtaining the Proceedings of two engineering societies in South Africa, and of six in Great Britain.

Professor Richards is still engaged upon the preparation of his book upon Ore Dressing, which will soon be ready for the press.

Professor Hofman's revised and enlarged edition of his work on the Metallurgy of Lead is now in press.

Professor Richards, with the aid of Mr. C. E. Locke, has prepared a paper on the Spitzkasten, which was read before the American Institute of Mining Engineers.

Professors Richards and Hofman have each contributed articles to "The Mineral Industry," the former on the Progress in Ore Dressing in 1896, the latter on Recent Improvements in Lead Smelting.

Course IV., Architecture. — During the past year there have been few changes made in the work of the Architectural

Department, but in several respects it has been greatly strengthened. Full-sized models of the Doric and Ionic orders from the theatre of Marcellus, made during the summer from the most accurate drawings obtainable, have been placed in the drawing-room of the second-year students. The shafts are omitted, for lack of height, but anticipating the time when the museum is certain to become an indispensable part of our plan, the models have been so constructed that they can be easily completed. They will then offer an opportunity for study which can only be surpassed in Rome itself. These models serve as our text-books, and are sketched, measured, and drawn out, giving a far better knowledge of scale and construction than can possibly be learned in any other way. It is needless to say that this instruction is carried on with much greater interest to the students. We have only two large models as yet, for we cannot afford to infringe on the area of the drawing-room; but the scheme should be carried to its completion as soon as possible, if the best results are to be obtained.

In Architectural History great improvement has been noticed in the interest and work of the students, due to the increased number of lectures and the concentration of the course in the second and third years. This change in the course scheme has given opportunity for the introduction of the study of the history of painting and sculpture, which has heretofore been carried on in a less systematic manner, whenever we have been able to procure a lecturer on these subjects. A course is now regularly established, in charge of Professor Sumner. It is certain to prove of much value and interest.

This year we have nine students engaged in graduate work. The value of this extra year becomes continually better appreciated, as is shown by the steady increase in numbers from year to year.

The students of the Institute, for the fifth time in succession, won both the competitions of the Beaux Arts Society

of Architects of New York, and, as before, bore off the gold medal and the highest honors.

The two Rotch Scholarships, each amounting to about two hundred dollars, were awarded this year to Mr. T. E. Videto, of South Framingham, and Mr. H. M. Seaver, of West Roxbury. Mr. Videto has returned this year as a candidate for an advanced degree.

The Boston Society of Architects also generously continued its two prizes of the value of fifty dollars each in books. A beautiful edition of Piranesi, the gift of Mrs. Henry Draper, has been added to the library, while Prof. W. R. Ware, of Columbia University, has presented two valuable lithographs, restorations, by Viollet-le-Duc, of a Doric Temple and the Baths of Caracalla.

Mr. Cass Gilbert, of Minneapolis, has most generously presented to the department a set of blue prints of the Brazer Building, in Boston, of which he was the architect, with his written description. Many novel conditions occurred in the planning of this building, and his methods of solving them are exceedingly interesting.

Mr. James M. Hubbard has also presented to the library three volumes of the Palestine Exploration Fund.

The department becomes more hampered each year for want of space and the proper adaptation of it to the present demands of architectural education. The museum is badly needed. The library has become entirely inadequate to allow of the proper care, use, or display of its exceedingly valuable collections. The drawing-rooms are crowded this year to their utmost capacity. The condition of things can be understood from the fact that we have twenty-two more students in the department than last year.

Courses V. and X., Chemistry and Chemical Engineering. — The President has retained the general direction of the Chemical Department and given the lectures upon organic chemistry, but it is hoped that during the coming year a new professorial appointment may be made. Thanks to the great zeal and

activity of the professors and instructing staff, the usual routine of work has been carried on satisfactorily.

The removal to the State House of the service of water analysis for the State Board of Health has permitted a rearrangement during the summer of the Rooms 36 and 38 of the Walker Building. The former is now devoted entirely to sanitary chemistry and to proximate analysis, and proves hardly sufficient for those purposes, not to speak of a rapidly increasing demand. A new laboratory course in proximate technical analysis has been introduced in place of the option in sanitary chemistry for the fourth-year students. This course, which has been in charge of Dr. Whitney, comprises the examination of a number of industrial products, such as asphalt, rubber, paper, soap, tannin, and fertilizers. Each student is required to look up the processes to be employed, and to present reports on his work before the class, so that an acquaintance with the literature of the several subjects is acquired by the class, and original thought is encouraged and developed. It is believed, moreover, that some practice in this line of work will prove of direct practical value to our chemists. The option has been chosen by a large number of the present fourth-year class. The investigation of the action of soft water upon boilers will be continued throughout the year, as well as that upon the ventilation of public buildings, and, among others, further studies in the purification of water and sewage will be carried out. Dr. Gill now occupies Room 38. The space used for oil and gas analysis has been divided into a small lecture and study room (seating twelve students) and a laboratory. The latter has desks for thirty-six students, accommodating fifteen at one time, and serves during the first term for oil analysis and the second term as a research laboratory for the students in chemical engineering.

The notes in oil analysis have been published under the title "A Short Handbook of Oil Analysis." They enable the instruction to be given much more thoroughly and systematically than before.

The equipment of the gas laboratory has been materially increased by the addition of a Junker calorimeter for determining the heating power of gases.

No important changes have been made during the year in the teaching of general Chemistry. The class numbers 380.

ANALYTICAL CHEMISTRY. — The students taking Analytical Chemistry number 119 in all; they are distributed as follows:

	Second year.	Third year.	Fourth year.
Mining Engineering	2	16	9
Chemistry	29	29	
Biology	4	2	
Physics	2		
Chemical Engineering	12	1	2
Sanitary Engineering		3	
Miscellaneous	8		
Total	57	51	11

This year, for the first time, it was necessary to refuse admission at the opening of the term to a few students whom we should otherwise have been ready to receive, because it was impossible to give them desk-room. Some of these have since been allowed to enter the laboratory, taking the place of students who have, for various causes, dropped the subject; but others could not be admitted at all. It is, of course, too early to state definitely the conditions which will prevail next year, but if the number of students entering the various courses remains the same as for the past two years, it seems improbable that we should be able to accommodate all who are rightfully entitled to desks in the laboratory but for the additional space gained by the erection of the new building. The unusually large number of students entering the Course in Mining Engineering last year (about 30), who will take analytical chemistry for the first time next year, will make a new demand upon our desk-room.

The equipment and instructing force remains unchanged, and the general scheme of instruction has only been modified in some minor details.

ORGANIC CHEMISTRY. — The additional places provided last year have been filled. Thirty students now take Organic Chemistry. The work in the laboratory has been facilitated by the new arrangements. No changes have been made in the instructing staff. The titles of researches on a following page give evidence of the activity of the instructing staff, and show that the students in their last year are brought in contact with teachers who are themselves doing the kind of original work which is the best training for a practical chemist.

Under the charge of Mr. Rolfe twenty-six students have been instructed in sugar analysis, with the use of the most approved model of polariscopic apparatus, and two students, Messrs. Faxon and Hemmings, have used these instruments in original investigations, under Mr. Rolfe's direction.

The class in Industrial Chemistry has increased from thirty-seven to fifty-two. The lectures delivered by Dr. Thorp have been supplemented as usual by outside lectures from chemists in charge of important manufacturing works in the neighborhood of Boston. A lecture on the manufacture of glue and gelatine by Mr. George R. Underwood, of the Upton Glue Works, has this year been added to the list.

Visits were made by the class last year to the following manufactories:

Merrimac Chemical Works, South Wilmington, Mr. A. P. Howard, superintendent.

Curtis Davis Soap Works, Cambridgeport, Mr. E. D. Mellen, manager.

Union Glass Works, Cambridgeport, Mr. J. de Cordova, president.

Malden and Melrose Gas Works, Malden, Mr. T. H. Hintze, superintendent.

The Tileston and Hollingsworth Paper Company, Mattapan, Mr. A. L. Hollingsworth, treasurer, Mr. Mossman, superintendent.

Publications of the Chemical Department.

1897.

Theoretical Chemistry.

W. R. Whitney: (1.) The Dilatometric Measurement of the Velocity of the Hydrolysis of Cane Sugar.

(2.) An Electrical Thermostat.

(3.) With A. A. Noyes: The Rate of Solution of Solid Substances in their own Solution.

A. A. Noyes: Bemerkung über die kinetische Theorie der Lösungen.

A. A. Noyes and [illegible] S. Wason: The Velocity of the Reaction between Ferrous Chloride, Potassium Chlorate, and Hydrochloric Acid.

A. A. Noyes and C. G. Abbot: (1.) Bestimmung des osmotischen Druckes mittelst Dampfdruckmessungen.

(2.) On the Relation between the Osmotic Pressure and the Vapor Pressure of Solutions.

A. A. Noyes and W. R. Whitney: Ueber die Auflösungsgeschwindigkeit von festen Stoffen in ihren eigenen Lösungen.

Analytical Chemistry.

A. A. Noyes: A Detailed Course of Qualitative Chemical Analysis. Third edition.

A. H. Gill: A Shorthand [illegible] of Oil Analysis.

A. A. Noyes: Synthesis of [illegible] thylene-Glycol Diethyl Ether and other Ethers from Trimethylene Glycol.

A. A. Noyes and S. P. Mulliken: Laboratory Experiments on the Class Reactions and Identification of Organic Substances. Second edition.

J. F. Norris: Action of the Halogens on the Aliphatic Amines and the Preparation of Perhalides from Them.

Sanitary Chemistry.

E. H. Richards:

(1.) Domestic Science, What it Is and How to study It.
(2.) Foods and Diet, Comparative Value.
(3.) A New Color Standard for Use in Water Analysis.
(4.) Notes on the Evidences of Dissociation in Dilute Soap Solutions.

Courses VI. and VIII., Electrical Engineering and Physics. — In these as in other courses the effects of the increased entrance requirements in mathematics have been advantageously felt during the past year, and will be still more evident during the present year, when they will affect the whole four years of the course. In the scheme for the fourth year of the Course in Electrical Engineering the time gained allows of a very large additional amount of practice in the study and testing of dynamo-electric machinery in the laboratory of electrical engineering — a need which has been strongly felt by the department for several years past, on account of the rapid introduction of entirely novel forms of such machinery. It has also been possible to make some extension in the time given to general electrical measurements and testing.

In part for the same reason, and in part because of the general advance in the level of the instruction in the third year, it has become possible in the fourth year to devote a larger number of exercises than hitherto to the principles of the design of dynamo-electric machinery. The course of instruction in designing dynamos was assigned last year to Mr. Louis Derr, Instructor in Physics. The results were highly satisfactory, and Mr. Derr will take charge of the enlarged course to be given this year. Thus the constant supervision of an instructor has replaced outside professional services. His work will be supplemented by a brief course of lectures by Mr. John B. Blood, M.I.T., '90, who has had large experience in dynamo design in connection with the General Electric Company.

In the Course in Physics (VIII.) there has been considerable readjustment of studies. The subject of the theory and methods of telegraphy, hitherto taken in connection with Course VI., was quite technical, and it has therefore been removed from Course VIII. and replaced by a course in photometry by Professor Clifford, transferred from the fourth year and at the same time extended. A brief course upon the kinetic theory of gases by Professor Goodwin will be inserted in the fourth year.

Other important changes allow the option of the simultaneous study of analytical chemistry and advanced mathematics in the third year, first term; and the requirement of Fourier's Series throughout the fourth year, of all candidates for a degree, the study of analytical mechanics in the fourth year becoming an option, with organic chemistry as an alternative. This arrangement has been desired for some time, but for certain reasons has not hitherto been possible.

It should also be mentioned that the instruction in general Physical Measurement has been materially extended for the students in the Course in Chemistry. Also it has been found possible to begin this work at the middle of the second year instead of a term later, so that this is now the case with the Courses in Chemistry, Physics, Electrical Engineering, and General Studies. This earlier start in accurate physical measurement is very desirable for several reasons. The work in the laboratory is thereby brought into closer relation to the lectures, the students pursuing it are less distracted by purely professional work, and the time in the later years is open for more advanced physical work when desired.

As in previous years the course has been much extended by the aid of the profession. During the past year, courses of lectures have been given by Mr. George W. Blodgett, Electrician of the Boston & Albany Railroad, on the Application of Electricity to Railway Signalling; Mr. Hammond V. Hayes, Electrical Engineer of the American Bell Telephone Company, on Telephone Engineering; Mr. Louis Bell, on the Electrical

Transmission of Power and the Application of Electricity to Railway Transportation; Mr. Hollis French, on Electrical Engineering Practice and Specifications; Mr. Howard C. Forbes, on the Design and Testing of Electric Light and Power Plants; Mr. Odin B. Roberts, on the Nature and Function of Patents for Inventions; and single lectures have been given by Mr. C. J. H. Woodbury, of the American Bell Telephone Company, on Electricity in its Relation to Fire Risks; Mr. Ernest A. LeSueur, on the Industrial Applications of Electro-Chemistry; Mr. S. Everett Doane, of the General Electric Company, on the Manufacture of Incandescent Lamps; and Professor Elihu Thomson, on Recent Lines of Development in Applied Electricity.

The equipment of the department has been greatly augmented during the last year. Especially noteworthy is the separate plant of combined dynamo-machines and steam-engine for testing, referred to in the President's report of last year as in process of erection. This is proving of the utmost advantage, not only in the work of the Course in Electrical Engineering, but to students of Mechanical Engineering as well. The installation is satisfactory in all respects. Some fear had been felt lest the room immediately above should be rendered noisy, but so smoothly does the machinery run that its action is not noticed.

Various important pieces of physical apparatus have also been added. Of these there should be particularly mentioned a cathetometer, with two telescopes, manufactured by the "Société Genevoise." This magnificent instrument was purchased from the fund bequeathed to the Institute by Mrs. Katharine Bigelow Lowell, and appropriated by the Executive Committee to the purchase of physical instruments. The cathetometer bears an inscription to this effect.

The increased interest which the discovery of the Röntgen rays has excited in the general subject of the passage of electricity through high vacua has led us to enlarge our collection of apparatus illustrative of this branch of physics, so

ists, engineers, or architects are liable to be brought unexpectedly face to face with sanitary problems. A large part of the civic or municipal engineering of the day is based upon the modern requirements of sanitation, and the Institute is fortunate in being able through its biological department to present adequately, yet concisely, to its students in other departments the fundamental facts, theories, and practice of sanitary science.

The new course in Industrial Biology begun last year has proved eminently successful, and credit in this connection is due to Mr. S. C. Prescott, Instructor in Biology, who, under the direction of Professor Sedgwick, has given largely of his time and thought to its development. The rapid growth of discovery in this direction makes it likely that more time will soon have to be given to the subject. The contributions to our knowledge of micro-organisms and sterilizing processes in the canning industry, begun last year by Messrs. Prescott and Underwood, have since been repeated in part by the Canadian Government, with confirmatory results. A preliminary account of the more recent researches of Messrs. Prescott and Underwood (upon the efficiency of the processes employed in the canning of sweet corn) had just been issued from our laboratory.

All these and similar contributions to applied biology, however, in the last analysis, rest upon the sure foundation of pure science; and it is therefore gratifying to note that the work in comparative physiology, under Assistant Professor Hough; in comparative anatomy and zoölogy, under Dr. Weysse; and in botany, under Mr. Prescott, continues to be of high efficiency. Assistant Professor Hough has published during the year an important paper on the physiology of inhibition. A valuable series of lectures by Dr. Bigelow, on theoretical biology, of which he has recently published a syllabus, is also worthy of mention.

Through the continued kindness of Mrs. William B. Rogers this department was again presented during the last year, as

has been the case for several years, with two annual scholarships in the Marine Biological Laboratory at Wood's Hole. These were held with great advantage by Messrs. C.-E. A. Winslow, of the fourth year, and C. W. Perley, a recent graduate of the department.

It is hoped that the project, described at length in the last report, can be carried out this year; and that the natural development of this department will no longer suffer from want of space for research laboratories. The thesis work of the fourth-year students and the original work of instructors and graduates or special students are most fruitful sources of scientific inspiration, and contribute essentially to maintain the enthusiastic feeling which marks the growth of a department. Increased accommodations are also called for on the ground of the public usefulness of biological experiments.

Course IX., General Studies. — English, History, Economics — Professor Bates has now in operation the plan arranged in conjunction with President Walker for the oversight of the English of students above the first-year grade. It is a singular fact that men who do good work in first-year composition seem to regard the need of care in writing as entirely done when they have once passed their examinations. Men whose first-term themes are really excellent sometimes fall into slovenly and incorrect habits of expression, so that their later written work is inexcusably bad. These students are now looked after, and are kept reminded of the fact that they are expected to live up to the standard which enabled them to pass in the first place.

The work in composition in the first year is also improved. The addition of an assistant to the staff of the department allows an increase of thoroughness, and makes possible a much greater amount of personal consultation.

An important gain has been made in adding advanced composition, formerly an option in the fourth year, to the required third-year studies of the Course. This has the advantage of giving to the students in the course a more

that it is probably unexcelled in this country. Various new vacuum tubes of our own devising have been added to it.

Through the kindness of Mr. George W. Blodgett the department has received the loan of a complete set of quadruplex telegraphic instruments, which has proved most useful in illustrating the lectures on that subject. We are also, as in previous years, greatly indebted to the American Bell Telephone Company for the use of much valuable apparatus.

The work of the laboratory of electrical testing is greatly facilitated by the new method employed for the support of the sensitive galvanometers. The Julius suspension, adopted by Professor Laws after a tentative trial of some months, has been found very satisfactory. The jarring of even the heaviest vehicles is without very serious effect, and ordinary disturbances of this kind are scarcely noticed.

The equipment of the laboratory of heat measurements has been increased by the construction, under the direction of Mr. C. L. Norton, of a comparator for thermometers, which, added to what we already possessed, renders our apparatus for comparing and examining standard thermometers exceedingly complete. The construction of two new coal calorimeters, one of the type of the Berthelot bomb, the other a simple and more easily manipulated form of calorimeter, permits of more complete examination of the efficiency of fuels than has hitherto been possible anywhere. The laboratory has further acquired a Heraeus thermo-electric pyrometer for measuring melting points, furnace and flue temperatures, and general technical work in heat measurements.

Regarding the difficulties under which the department labors on account of lack of room, there is nothing to be said beyond what was stated in the President's report of last year. The pressure has not diminished, but, realizing the impossibility of immediate remedy, the instructing force has used its best endeavors to so distribute the work as to relieve the

congestion as far as possible. This has often necessitated a frequent repetition of exercises, with corresponding draught on the time and strength of the instructors. In the laboratories of heat measurements and physical chemistry the crowding has been most extreme, but the work of this character has been satisfactorily, though not easily, carried through as laid out in the programme. But it has not yet been possible to extend it as might be done under more propitious circumstances as to accommodations.

Course VII., Biology. — Professor Sedgwick reports that the more elementary class-work is efficient and satisfactory, but states that the opportunities for advanced work and investigation are totally inadequate. He urges that provision be made at the earliest possible moment for a considerable increase in laboratory accommodations, especially for research, in his department. To show how pressing this need is he further states that an important and eminently practical investigation, which he has long had in view, upon the microscope structure of the various textile fibres, particularly hemp and sisal, is now ready to be set on foot as soon as space can be found in which to carry on the work. Room is also urgently required for experiments on the effect of certain processes in dyeing, upon the microscopic structure of the fibres treated; for further investigations upon milk and water; for experiments affecting the arts of canning and food preserving, as well as for certain special researches in pure bacteriology.

The notable growth of the work of this department along practical sanitary and industrial lines, which was dwelt upon at some length in the last report of the President, continues and is bearing fruit. Nowhere in America, perhaps, are the fundamental principles of sanitation and their application to the great public supplies — water, milk, and gas — more carefully considered or more intelligently taught. This is important not only to the public welfare of the community at large, but also to those of our own graduates who as chem-

ists, engineers, or architects are liable to be brought unexpectedly face to face with sanitary problems. A large part of the civic or municipal engineering of the day is based upon the modern requirements of sanitation, and the Institute is fortunate in being able through its biological department to present adequately, yet concisely, to its students in other departments the fundamental facts, theories, and practice of sanitary science.

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complete training in composition; it has also made room for the introduction of a course in argumentation as an option in the fourth year. Coming in the first half of the year, this course is an excellent preparation for thesis work.

The work in Literature has not undergone much change during the year, except that in the second year the course has been to some extent modified in connection with the required summer reading. There is in the fourth year of the Course an increase of written work in connection with eighteenth and nineteenth century literature.

In Economics there has been but little change. The department, however, has been called upon to give a course to the fourth-year students in Electrical Engineering, on Economics of Corporations. The more detailed studies of Dr. Ripley on the Racial Geography of Europe, delivered last spring in the Lowell course, are now being published in the "Popular Science Mo[illegible]." Prof. Dewey has been appointed to serve as a [illegible]r of the Boston Department of Municipal Statistics.

Course XII., Geology. — During the year several quite material changes in the succession of studies have been necessitated by the desire to modify certain courses in other departments. There have been but two options in the Course in Geology, and those were confined to the first term of the fourth year, but in the present schedule two options are offered in the second year and three in the succeeding years. By this arrangement students may devote certain portions of their time to an increased amount of either chemistry, comparative anatomy, or surveying.

Mr. M. L. Fuller, a graduate of the Institute of '96, who was last year engaged upon the Geological Survey of Michigan, is now an Assistant in this department.

There have been important additions to the collections and appliances for teaching. A most valuable accession has been made of a good series of large physical and geological wall-maps.

A large number of the Reports and Atlases of the Geological Survey of Pennsylvania, by Henry D. Rogers, have been given to the department by Mrs. H. D. Rogers and Miss Mary Otis Rogers, for distribution among other institutions. Correspondence has been conducted with fifty colleges and universities, and sets of the volumes have been furnished to thirty-six of them. The correspondence, the selection and transmission of these, has required a large amount of work, but it has promoted our friendly relations with other institutions.

Course XIII., Naval Architecture. — Few changes have been made in this Course since its commencement. The students are now given the accepted theory of their profession, mainly from notes especially arranged to conform to the methods of instruction of the school, and to use to best advantage the knowledge acquired in the engineering courses.

The preparation of such notes and the work of instruction in this subject are greatly facilitated by the sound training of the students in physics, applied mechanics, and steam engineering, which allows of a brief and comprehensive statement of many subjects which are ordinarily treated at length in works on shipbuilding and naval architecture.

Mr. Swan, who has returned after a year's study on leave of absence abroad, is now using his experience there to improve and extend the instruction given by him in drawing, ship calculations, ship construction, and design.

It is hoped that the new building will afford space for a drawing-room with large tables specially adapted to the requirements of naval designing. The need is greatly felt in this department of a room for storing safely and arranging for use drawing instruments and models such as those which have served for important work in the study of resistance and stability.

Last winter a set of progressive speed trials was made on the police boat "Guardian," by permission of the Board of Police Commissioners, over a well-defined course in the

harbor. The analysis and discussion of the results of these trials formed the subject-matter of the thesis presented at graduation by one of the class that was graduated last June, and have since been embodied in a paper presented to the American Society of Naval Architects and Marine Engineers.

Instruction was given in mould-loft work at the Navy Yard, as has been done for several years, through the courtesy of the Secretary of the Navy and of officers in the Navy Department. It is hoped that this valuable work may form a fixed feature of the Course.

Mathematics. — The work of the department has been conducted during the year without essential change. The advance in 1895 in entrance requirements has now reached its full effect, however, in the transference from the fourth year to the third year of the course in differential equations.

The department library is now provided with the more important periodicals, and with an adequate collection of models. An increase in the supply of important works of reference is, however, much desired. All the elective courses have been taken during the year, and a more advanced course in elliptic functions is now conducted by Professor Woods.

Modern Languages. — The department necessarily depends immediately upon the standard of the entrance requirements for the extent to which its teaching can be developed, so that no important change is to be expected until further advance is made in the preparation of the entrance class. So far as the modern languages are destined to be used to afford free access to foreign text-books, such as is frequently required in many professional studies, the excellence of our teaching is continually put to the test with satisfactory results. It is found in the different departments that the students in their third and fourth years read French and German sufficiently well for the consultation of text-books.

Professor van Daell recommends that uniformity in the teaching of the different sections shall be secured by the employment at frequent periods of written tests identical in all

sections. The use of a part of the time of an assistant would be required for the examination of papers.

There have been no considerable accessions to the library. The allowance for the purchase of books is used chiefly for the most useful books of reference.

STATISTICS OF CLASSES.

The Entering Class.

The registration of this year, as by the Catalogue now in press, amounts to 1,198, exactly the same as twelve months ago.

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1882–83	368
1866–67	137	1883–84	443
1867–68	167	1884–85	579
1868–69	172	1885–86	609
1869–70	206	1886–87	637
1870–71	224	1887–88	720
1871–72	261	1888–89	827
1872–73	348	1889–90	909
1873–74	276	1890–91	937
1874–75	248	1891–92	1,011
1875–76	255	1892–93	1,060
1876–77	215	1893–94	1,157
1877–78	194	1894–95	1,183
1878–79	188	1895–96	1,187
1879–80	203	1896–97	1,198
1880–81	253	1897–98	1,198
1881–82	302		

Students by Classes.

The aggregate number of students for 1897–98 is divided among the several classes as follows:

Graduate student, candidates for advanced degrees	9
Regular students, Fourth Year	203
" " Third "	178
" " Second "	197
" " First "	279
Special students	332
Total	1,198

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Graduates of the M.I.T.	9		9
Fourth Year	203	72	275
Third Year	178	91	269
Second Year	197	130	327
First Year	279	39	318
Total	866	332	1,198

Statistics of Examinations.

Of the 1,198 students of the present year, 441 were not connected with the school in 1896–97. Of these, 259 were admitted as regular students of the first year upon the basis of their entrance examinations. The 182 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 259 who were thus admitted to the Institute on examination, and those taken their place in the school, 91 were admitted on examination, but have not entered the school. The number of this last class, always large, has this year been increased even over that of last year by the continued depression in business.

In the case of the 259 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear		192
"	on one condition	34
"	on two conditions	23
"	on more than two conditions	10
		259

Fifty applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Belmont (Cal.), Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Easthampton (Mass.), Exeter (N.H.), Indianapolis, Kingston (Pa.), Lawrenceville (N.J.), Lead (So. Dak.), Louisville, New York, Philadelphia, Pittsburgh, Portland (Me.), Pottstown (Pa.), Poughkeepsie, Southborough (Mass.), St. Paul, Utica (N.Y.), Washington.

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	1	3	1	6	3	9
Colorado	..	1	3	..	2	6	2	8
Connecticut	..	7	3	3	14	26	4	30
Delaware	1	1	1	..	1	4	2	6
Dist. of Columbia	..	1	3	..	3	7	6	13
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	1	1	..	3	1	4
Idaho	..	..	1	..	..	1	..	1
Illinois	1	5	7	12	4	29	11	40
Indiana	..	..	1	1	2	4	3	7
Iowa	..	1	4	2	1	8	4	12
Kansas	..	2	..	..	..	2	1	3
Kentucky	..	2	3	1	2	8	2	10
Louisiana	..	..	..	..	1	1	..	1
Maine	..	6	4	6	3	19	5	24
Maryland	..	1	2	..	2	5	3	8
Massachusetts	7	133	102	133	176	551	188	739
Michigan	..	1	2	1	1	5	..	5
Minnesota	..	..	1	..	4	5	3	8
Missouri	..	..	2	1	1	4	2	6
Montana	..	1	..	..	3	4	1	5
Nebraska	..	1	..	..	..	1	1	2
New Hampshire	..	5	3	5	5	18	7	25
New Jersey	..	4	2	1	2	9	6	15
New York	..	12	5	8	15	40	22	62
North Carolina	..	..	..	1	..	1	..	1
Ohio	..	4	2	4	10	20	10	30
Oregon	..	1	..	..	..	1	2	3
Pennsylvania	..	5	5	6	10	26	15	41
Rhode Island	..	3	5	2	3	13	6	19
South Carolina	..	..	..	1	1	2	2	4
Tennessee	..	1	1	..	1	3	..	3
Texas	..	1	..	..	..	1	1	2
Utah	..	..	2	..	..	2	1	3
Vermont	..	..	2	3	2	7	4	11
Virginia	..	1	2	..	..	3	1	4
Washington	..	..	..	1	1	2	2	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	..	2	..	1	3	3	6
Foreign Countries.								
Cuba	..	..	1	..	..	1	..	1
Denmark	..	..	..	..	2	2	..	2
England	..	..	1	1	..	2	..	2
France	..	..	..	1	..	1	..	1
Mexico	..	..	..	..	3	3	3	6
New Brunswick	..	..	2	..	..	2	..	2
Nova Scotia	..	..	1	..	..	1	..	1
Quebec	..	1	..	..	..	1	1	2
Turkey	..	..	1	..	..	1	2	3
Total	9	203	178	197	279	866	332	1198

Forty States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,198, 739 are from Massachusetts, or 61.6 per cent. of the whole; 109 are from other New England States; 350 are from outside New England. Of these 20 are from foreign countries.

A table showing the number of students in each year, from 1891, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Alabama	2	4	2	1	..	1	1
Arkansas	3	2	1	..	..	1	1
California	19	14	15	9	8	9	9
Colorado	7	7	5	8	7	7	8
Connecticut	30	27	30	29	27	24	30
Delaware	..	2	4	3	5	5	6
Dist. of Columbia	4	4	7	13	16	17	13
Florida	3	4	3	2	1	..	1
Georgia	2	3	3	2	2	3	4
Idaho	1	1	1	..	1	1	1
Illinois	32	40	39	36	42	45	40
Indiana	3	5	6	3	2	3	7
Iowa	10	10	13	10	12	14	12
Kansas	2	1	1	4	4	3	3
Kentucky	8	7	11	12	11	12	10
Louisiana	5	2	3	3	2	..	1
Maine	27	39	36	38	38	27	24
Maryland	7	6	4	4	9	9	8
Massachusetts	595	603	605	707	721	730	739
Michigan	13	10	7	8	7	6	5
Minnesota	13	13	11	9	5	7	8
Missouri	12	13	17	14	9	11	6
Montana	..	..	2	2	1	3	5
Nebraska	1	4	3	4	2	2	2
Nevada	3	3	2	2	..	..	..
New Hampshire	24	29	32	27	30	26	25
New Jersey	16	11	6	5	5	13	15
New Mexico	1	2	2	1	1	..	..
New York	40	50	52	59	64	69	62
North Carolina	1	1	..	..	..	1	1
Ohio	33	39	45	50	37	28	30
Oregon	1	2	1	1	1	4	3
Pennsylvania	26	25	31	37	36	42	41
Rhode Island	26	24	33	25	21	20	19
South Carolina	4	1	3	3	5	6	4
Tennessee	4	1	1	1	1	1	3
Texas	2	5	6	6	3	2	2
Utah	..	1	2	2	5	2	3
Vermont	5	4	5	3	5	7	11
Virginia	6	4	3	2	5	3	4
Washington	3	3	1	3	1	5	4
West Virginia	2	2	1	1	3	2	1
Wisconsin	7	9	11	6	7	6	6
Wyoming	..	..	..	..	..	1	..
Foreign Countries.							
Belgium	..	1	1	1	..	..	..
Brazil	4	..	..	1	1	..	..
Bulgaria	1	1	1	..	..	..	..
Central America	1	1	1	..	1	..	..
Chile	..	..	..	1	1	1	..
Columbia	2	..	..	..	..	..	..
Cuba	..	..	1	1	3	2	1
Denmark	..	..	..	..	..	..	2
England	1	1	1	..	2	2	2
France	1	1	1	..	..	1	1
Germany	..	..	2	1	..	..	..
Guatemala	..	1	..	..	..	..	..
Hawaiian Islands	4	2	2	..	..	..	..
Holland	2	2	2	2	..	..	..
Ireland	..	..	1	1	..	..	..
Japan	3	1	1	1	2	2	..
Mexico	1	1	1	1	1	3	6
New Brunswick	2	1	1	1	1	2	2
New South Wales	1	1	1	1	1	..	..
Nova Scotia	1	..	..	1	2	1	1
Ontario	2	2	4	4	2	2	..
Peru	1	..	..	..	..	..	..
Porto Rico	1	..	1	1	1	..	..
Quebec	4	5	5	2	2	2	2
Scotland	2	1	2	1	..	..	..
Spain	..	1	1	1	1	..	..
Trinidad	1	..	..	..	..	..	..
Turkey	2	1	..	1	3	1	3
Venezuela	1	..	1	1	1	1	.
Total	1011	1060	1157	1183	1187	1198	1198

Residence of Massachusetts Students.

It has been said that 61.6 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-four cities and towns are borne on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-eight and Suffolk two hundred twenty-four pupils; Essex comes third, with ninety; Norfolk, fourth, with sixty-seven.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable . .	4	6	Hampshire . .	2	2
Berkshire . . .	6	8	Middlesex . .	32	248
Bristol	5	28	Nantucket . .	1	1
Dukes	1	1	Norfolk . . .	15	67
Essex	25	90	Plymouth . . .	11	25
Franklin . . .	2	2	Suffolk	3	224
Hampden . . .	4	12	Worcester . .	13	25
			Total . . .	124	739

The following is a list of the towns, thirty-seven in number, which send four or more students to the Institute:

Boston . .	210	New Bedford,	9	Springfield .	6
Newton . .	48	Salem . . .	9	Wellesley .	6
Cambridge .	42	Brockton . .	8	Fitchburg .	5
Brookline .	25	Concord . .	8	Natick . .	5
Newburyport	22	Gloucester .	8	Peabody . .	5
Malden . .	21	Melrose . .	8	Haverhill . .	4
Somerville .	19	Winchester .	8	Milton . .	4
Lowell . .	16	Framingham .	7	Plymouth . .	4
Hyde Park .	13	Taunton . .	7	Reading . .	4
Lynn . . .	12	Waltham . .	7	Weston . .	4
Chelsea . .	11	Worcester .	7	Woburn . .	4
Arlington .	10	Fall River .	6		
Medford . .	10	Lawrence .	6		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1888–89	827	465	362	245	117
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and sixteen persons of unusual ages. These deductions

Period of Life.	1896–97.		1897–98.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years . . .	2	..	1	..
16½ to 17 " . . .	3	5	1	2
17 to 17½ " . . .	19	..	16	..
17½ to 18 " . . .	40	59	33	49
18 to 18½ " . . .	52	..	43	..
18½ to 19 " . . .	44	96	39	84
19 to 19½ " . . .	41	..	58	..
19½ to 20 " . . .	28	69	25	83
20 to 20½ " . . .	23	..	25	..
20½ to 21 " . . .	9	32	9	34
21 to 22 " . . .	11	11	9	9
	272	272	261	261

leave two hundred and sixty-one as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1896–97.

From the foregoing, it appears that the average age on entrance is eighteen years and eleven months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and seventy-six members of the class were distributed among the different periods of life as follows:

Between	20	and	20½	1
"	20½	"	21	11
"	21	"	21½	18
"	21½	"	22	26
"	22	"	23	59
"	23	"	24	36
"	24 and over			25
Total				176

The special students this year constitute twenty-eight per cent. of the whole body, as against twenty-seven per cent. last year, and twenty-eight per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is seventy-two. Of these, ten are our own graduates, nine being candidates for advanced degrees; sixty-two are graduates of other institutions, pursuing courses of study with us, either as regular or as special students. Fourteen are graduates of Harvard University; five of Yale University; four of Williams College; three each of Georgetown University, Amherst College, and Smith College; two each of Johns Hopkins University, De Pauw University, and University of Chicago, while the following institutions are represented on our list by a single graduate each: Rochester, Minnesota, Oregon, Vermont, Princeton, Brown, Iowa State, Colby, Ohio State, and Indianapolis Universities; Carleton,

Hampden-Sidney, Central Turkey, Monmouth, Dickinson, Gonzaga, Wellesley, Boston, Tufts, Hamilton, Simpson, South Kentucky, Trinity Colleges; Colegio de Carreras.

The graduates of the Institute who are candidates for advanced degrees are Messrs. George Vincent Wendell, of the class of '92, the holder of the Savage Fellowship, in Physics, William David Coolidge, of the class of '96, the holder of the Swett Fellowship, in Physics, both studying abroad; Mr. Albert Ernest Smyser and Mr. James Swett Smyser, of the class of '96; Messrs. John Arthur Collins, Jr., Irénée du Pont, Frank Warren Everett, Edmund Sewall Manson, Jr., Theodore Ernest Videto, all of the class of '97.

Women as Students at the Institute.

The number of women pursuing courses with us is sixty-nine. Of these, five are graduates of colleges. Of the total number, five are regular students of the fourth year; one of the third year; five of the second year; five of the first year. Fifty-three are special students. Of the eleven regular students of the upper classes, three take Course IV., Architecture; four, Course V., Chemistry; two, Course VII., Biology; two, Course VIII., Physics. Of the special students, thirty devote themselves to Biology, five to Chemistry, three to Architecture, six to General Studies, three to Physics, three to Geology, one to Mathematics and two to Sanitary Engineering.

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	32	41	7	29	23	40	3	6	4	10	2	..	7	203*
3d " "	40	38	8	20	19	30	2	1	1	11	1	..	11	178*
2d " "	37	40	23	22	18	20	3	2	5	15	4	1	8	197*
Total . . .	109	119	38	71	60	90	8	9	10	36	7	1	26	578*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1887	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*

* Deducting those counted twice.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..		..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..		..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..		1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	..	..	..	..	27
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	15	23	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
Totals	344	406	152	125	196	1	319	31	26	67	61	21	8	19	1,773
Deduct names counted twice															11
Net total															1,762

* Deducting names counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d	7	..	3	..	1	..	1	1	..	1	..	..	..	..
3d	6	1	3	..	2	..	..	..	..	..	..	..	..	..
4th	10	2	3	..	1	1	2	..	..	..	..	..	..	1
5th	10	..	1	1	1	..	3	..	1	1	1	..	..	1
	37	3	10	1	5	1	6	1	1	2	1	0	0	2

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics	65	Language	172
Architecture	60	Mathematics	147
Biology	51	Mechanical Engineering	77
Chemistry	134	Mining Engineering	12
Civil Engineering	46	Naval Architecture	2
Drawing	158	Physics	168
Electrical Engineering	15	Political Science	61
English	133	Sanitary Engineering	6
Geology	46	Shopwork	74
History	100		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics. . .	308	308	115	47	778
Chemistry	371	55	83	55	564
English	299	274	13	6	592
French	162	84	50	....	296
Physics	....	287	278	227	792
German	81	208	149	5	443
Shopwork	11	110	50	67	238

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: On behalf of the Executive Committee of the Society of Arts, I beg to submit the Annual Report of the proceedings of the Society for the year 1896–97, as required by the By-laws.

At the adjourned annual meeting held May 27, 1897, Messrs. George W. Blodgett, Desmond FitzGerald, Thomas Doane, Edmund H. Hewins, and Frank W. Hodgdon were duly elected members of the Executive Committee, and Dr. Robert P. Bigelow was reëlected secretary for the ensuing year. The Executive Committee presented the following report, which was accepted and placed on record:

With the close of this thirty-fifth year of its existence, the Society of Arts has passed its five hundredth meeting. During the present year there have been held fourteen meetings, at which sixteen papers have been read. One meeting was a special one, held jointly with the Boston Society of Civil Engineers, to listen to a paper on the "Tampico Harbor Works" by the eminent engineer, Mr. E. L. Corthell. Three notable papers have been presented showing the summer work of the Institute. One of these was by Professor Homer, on the "Summer School of Architecture in Europe." The other two were by Professors Burton and Barton on the results obtained by the "Boston Party on the Sixth Peary Expedition to Greenland." All three of these papers will be published in the current volume of the "Technology Quarterly," and in addition to these an exceptionally valuable article on the "Pendulum and Magnetic Observations" has been contributed by Mr. Putnam, a member of the Boston

party. Another paper that deserves special mention, both because of its intrinsic value and because it embodied the results of original work done by a member of the Society, and largely in the laboratories of the Institute, is the one read by Dr. Williams on "Some Applications of the Röntgen Rays."

The endeavor has been made to publish the papers presented before the Society, as far as possible, in the "Technology Quarterly," but some papers have been crowded out or have been much delayed, owing to lack of space. As it is, the size of the last two numbers of the "Quarterly" has been much greater than the finances of the Society will warrant, and future numbers will have to be much smaller, even if that necessitates the omission of valuable contributions. The Results of Tests made in the Engineering Laboratories are regarded as an especially valuable feature of the "Quarterly," and although a source of very considerable expense, it is hoped that it will be possible to continue their publication.

The most momentous event in the history of the Society during the year is the death of President Walker, which has been felt more keenly, perhaps, by the members of the Executive Committee than by the other members of the Society, for their duties brought them into closer personal relations with him, and they have been better able to observe the thoughtful interest and wide knowledge of affairs that General Walker brought to the aid of the Committee in its efforts to guide the course of the Society.

At the time of the previous annual meeting the Society had 67 life members. Seven of these have died during the year, leaving 60 as the present number. The number of associate members a year ago was 289. Three have died and 9 have resigned. This loss is more than offset by the addition of 34 new members; making the present number of associate members 311.

The life members who have died during the year are Thomas T. Bouvé, George O. Carpenter, William O. Grover, Henry D. Hyde, G. F. H. Markoe, O. W. Peabody, John

Ruggles, and George W. Wales; the associate members are Henry A. Craigin, James H. Stanwood, and Francis A. Walker.

Respectfully submitted,

ROBERT P. BIGELOW,
Secretary.

DEC. 4, 1897.

THE TECHNOLOGY CLUB.

In the report of last year, reference was made by President Walker to the recently formed Technology Club, although, as he stated, it does not come strictly within the cognizance of the Corporation. The experience of the year has demonstrated, however, even beyond the expectations of the promoters of this Club, the usefulness to the Institute of such a meeting-place for the members of its governing and teaching bodies and its past students. Not simply through the ordinary intercourse of club life, but more especially by the frequent social meetings and class dinners that have been held in the club-house, an extraordinary interest in the work of the Institute has been aroused among its past members, and very active forces for the promotion of its welfare have been set in motion.

The use of the rooms of the Club for various minor purposes of the School is, in itself, of much value to us; and by its policy of admitting a number of undergraduates to full membership, the Club is contributing in no slight degree to the promotion of good order and of high ideals within the student body.

For these and other reasons I am convinced that the Technology Club, while not an integral part of our organization, should receive the cordial support of all who are concerned in promoting the welfare of the Institute.

A number of classes that had never come together since their graduation have organized, and have reunited their

scattered members, with the result that many to whom the Institute of Technology had been but a name have become its zealous and intelligent supporters.

The Association of Class Secretaries. — In connection with the Technology Club an important step has been taken in the organization of the Association of Class Secretaries. This association includes the secretaries of the various graduate classes, and has added also to its membership representatives of the Alumni Association, of the Technology Club, of the undergraduates, and the Secretary of the Institute.

The object of the society is "to promote class spirit and the welfare of the Institute, and to systematize all matter pertaining to class organization and record."

In pursuance of these objects it has through committees prepared careful plans for the systematic conduct of the business of alumni classes, and has effected the formation of organizations where none had existed before, and has revived the interest of others which had been long dormant.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER

THE treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1897.

The amount paid for salaries increased about six thousand dollars, and there was also an increase in the repair account to the amount of about two thousand dollars.

Savings have been made in the payments for fuel, supplies, and some other matters to the amount of about seven thousand dollars.

The net result is that the income, including the twenty-five thousand dollars received from the State of Massachusetts, has just about equalled the expenses — there being a deficit of only four hundred and twenty-five dollars and four cents.

From the John W. and Belinda Randall Charities Corporation there have been received fifty thousand dollars.

Seven thousand four hundred and eighty-five dollars and ninety-one cents have been added to the Ann White Vose Scholarship Fund by a final payment from her estate.

Similarly a supplementary payment of nine hundred and twenty-three dollars and thirty-three cents has been received from the estate of the late Susan E. Dorr; and one of one hundred and ninety-six dollars and twenty-one cents from that of the late Samuel E. Sawyer.

Mrs. Wm. B. Rogers has kindly given two hundred dollars for periodicals; and other gifts, amounting in all to nine hundred and twenty-five dollars, have come from other friends of the Institute.

The debt has been reduced during the last year from one hundred and fifty thousand dollars to one hundred and twenty thousand.

SECURITIES EXCHANGED, W. B. ROGERS MEMORIAL FUND.

$50,000 Saginaw & Western R.R. 6s.	50,000.00

RECEIVED.

$37,500 Detroit, Grand Rapids & Western R.R. 4s., 1946 .	37,500.00
255 shares " " " " " " Pf'd .	12,500.00

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

16 Rights Boston Real Estate Trust	100.00
$1,000 Bur. & Missouri R.R. 6s., 1918	1,000.00

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$1,000 Bur. & Missouri R.R. 6s., 1918, non-exempt . . .	1,077 50
1 share Boston Ground Rent Trust	900 00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 30, 1896		22,323.15
From Augustus Lowell for Lowell Courses	5,700.00	
" " " " C. Kastner's salary	2,500 00	
" " " " School of Design	500 00	
		8,700.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,942.00	
" " " " scholarships (students' fees)	6,400.00	
" " " " Joy "	200 00	
" " " " Swett "	400 00	
" " " " Savage "	400.00	
" " " " Library	540.00	
" " " " general purposes	9,196.43	
" " Rogers Memorial Fund	9,814.00	
" " Charlotte B. Richardson Fund	1,682.04	
" " Rotch Prize Funds	450.00	
Letter Box Fund used 1896 [59.75]	175.00	
Biological Instrument Fund used 1896	356 50	
Mathematical Department Fund used 1896	250.00	
Students' fees	215,045.00	
State Scholarships	4,000.00	
State Agricultural Fund	5,896.00	
State Endowment Fund	7,666.67	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	9,902.17	
Rents, per Table (page 84)	15,274.23	
Gifts	1,125.00	
Interest	5,020.58	
Boston University	1,150.00	
Sale printed Lecture Notes	2,753.28	
		326,638.90
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Richard Perkins Fund	103.50	
" James Savage Fund	178.38	
" Susan Upham Fund	53.66	
" Dalton Graduate Chem. Fund	229.05	
" T. Sterry Hunt Fund	138.72	
" James H. Mirrlees Fund	120.41	
" W. B. Rogers Fund [additional 52]	277.93	
Susan E. Dorr Fund [" 923.33]	1,085 15	
Ann White Vose Fund [" 7,485.91]	7,949.80	
		10,136 60
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Samuel E. Sawyer Legacy, additional	196.21	
John W. & Belinda Randall Fund	50,000.00	
		50,196.21
SECURITIES SOLD OR PAID. GENERAL FUND, page 75		1,100.00
SUNDRIES.		
Income credited to Bond Premium Acc't	495.40	
Income credited to Rogers Bond Premium Acc't	500 00	
Boston Art Students' Asso. on acc't	666.67	
Students' notes paid	937.50	
		2,599.57
		$421,694.43

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPTEMBER 30, 1897.

	Cr.	
Paid for Lowell Courses	5,700.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,700.00
EXPENSES.		
Salaries, per Table (page 84)	222,744.42	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	450.00	
Repairs, per Table (page 85)	11,232.57	
General Expenses, per Table (page 85)	14,122.07	
Fuel	6,600.48	
Water	2,020.40	
Gas	2,241.35	
Electricity	1,111.27	
Printing and Advertising	2,463.42	
" Lecture Notes	1,697.38	
" Annual Catalogues and Reports	2,790.53	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 84)	34,885.28	
Society of Arts	2,164.60	
Interest allowed on funds not in Bonds and Stocks, at 4½ per cent	6,662.05	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	4,630.00	
Mech. Eng. & Applied Mechanics Department Improvements	2,657.89	
Physical Department Improvements	4,310.58	
Architectural " "	993.15	
Mathematical Department	250.00	
Biological Instrument Department	356.50	
		327,063.94
[Expenses more than Income, $425.04]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 75		1,977.50
Projected Building, Trinity Place, plans		74.07
SUNDRIES.		
Notes Payable	30,000.00	
Notes Receivable	17,000.00	
Students' Deposits	250.00	
Funds of 1896, used	666.25	
		47,916.25
Cash balance, Sept. 30, 1897		35,962.67
		$421,694.43

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1897: —

	INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.			
$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Clinton & Springfield R.R. 5s.	1925	16,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
5,400.00	Republican Valley R.R. 6s. . . .	1919	5,400.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000.00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R.R.			
	1,000 General Mortgage 4s. . . .	1934		
	2,000 Income 5s.	1934		
			2,221.40	
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00	
42,000.00	Chicago, Burlington & Quincy R.R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, Grand Rapids & Western R.R. 4s.	1946	37,500.00	
	255 Shares Detroit, Grand Rapids & Western Pfd., par 100		12,500.00	
	Advance to Bond Premium account .		7,900.00	
	Bonds and Stocks			249,953.90
	INVESTMENT OF THE JOY SCHOLARSHIP FUND.			
	Massachusetts Hospital Life Insurance Co. .		5,000.00	
	Deposits in Savings Banks		4,123.70	
				9,123.70
	INVESTMENT SWETT SCHOLARSHIP FUND.			
	Massachusetts Hospital Life Insurance Co.			10,000.00
	INVESTMENTS, GENERAL ACCOUNT.			
$14,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
6,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	5,100.00	
3,000.00	Milwaukee & St. Paul R.R. 7 3-10 .	1898	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00	
15,000.00	Chicago, Burlington & Quincy R.R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s. . . .	1913	2,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
5,000.00	New York & New England R.R. 6s.	1905	5,000.00	
	Advances to Bond Premium account		5,121.94	
	Bonds			195,221.94
	Amount carried up			$464,299.54

Amount brought up 464,299.54

STOCKS.

SHARES.					
148	Boston & Albany R.R.	par	100	29,933.00	
194	Morris & Essex R.R.	"	50	14,690.00	
40	New York & Harlem R.R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00	
50	N.Y., New Haven & Hartford R.R.	"	100	8,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	600.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
1	Laconia Co.	"	400	605.00	
2	Pepperell Manufacturing Co.	"	500	2,300.00	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
15	Consolidated Gas Co., New York	"	100	1,447.50	
7	Lowell Gas Light Co.	"	100	1,610.00	
40	Cambridge Gas Light Co.	"	100	7,000.00	
7	Lawrence Gas Light Co.	"	100	882.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
10	First Nat. Bank of Baltimore	"	100	1,293.30	
16	Boston Real Estate Trust	"	1000	18,300.00	
1	Boston Ground Rent Trust	"	1000	900.00	
					179,255.50

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, Trinity Place .	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architects' "		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Projected Building, Trinity Place, plans . . .		243.57	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge .		16,154.38	
			989,383.13
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80

SUNDRIES.

Notes Receivable	78,500.00	
Boston Art Students' Association	12,333.33	
Students' Notes	1,845.50	
Cash Balance, Sept. 30, 1897	35,962.67	
		128,641.50
		$1,798,763.47

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	50,000.00	
		479,590.11

The income of the following is used towards paying salaries: —

Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
		87,600.00

SCHOLARSHIP TRUSTS.

Richard Perkins Fund	53,278.67	
James Savage Fund	13,431.20	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,652.20	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000 00	
James H. Mirrlees Fund	2,796.19	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	61,182.16	
Dalton Grad. Chemical Fund	5,319.05	
		204,979.23

OTHER TRUSTS.

Charlotte Billings Richardson, Industrial Chemistry Fund	37,378.78
Susan Upham Fund	1,246.13
Susan E. Dorr Fund	3,757.80
William Hall Kerr, Library Fund	2,000.00
Biological Instrument Fund	143.50
Charles Lewis Flint, Library Fund	5,000.00
Rotch Arch. Library Fund	5,000.00
Rotch Architectural Fund	25,000.00
Rotch Prize Fund	5,225.00
Rotch "Special" Prize Fund	5,225.00
Letter-box Fund, balance	110.37

MISCELLANEOUS.

Notes Payable	120,000.00	
Students' Deposits	250.00	
Catherine P. Perkins Legacy, 1893	102,781.40	
Henry E. Hutchins Legacy, 1895	2,000 00	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000 00	
Susan G. Coolidge Devise, 1896	14,005.00	
M.I.T. Stock Account	681,976.15	
		936,507.55
		$1,798,763.47

Comparative Statement of Funds, etc.

	Sept. 30, 1896.	Sept. 30, 1897.
Trusts for general purposes	429,393.90	479,590.11
" " Salaries	87,600 00	87,600 00
" " Scholarships	195,981.44	204,979 23
" " Library	7,000 00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,192.47	1,246.13
Susan E. Dorr Fund	2,672.65	3,757 80
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000 00	25,000.00
Rotch Prize Fund	5,225 00	5,225.00
Rotch "Special" Prize Fund	5,225 00	5,225.00
Catherine P. Perkins Legacy	102,781.40	102,781.40
Henry E. Hutchins "	2,000 00	2,000 00
Moses Kimball "	5,000.00	5,000.00
Benj. P. Cheney "	10,000 00	10,000.00
Susan G. Coolidge Devise	14,500 00	14,500.00
Letter-box Fund	170 12	110.37
Biological Instrument Fund	500 00	143.50
Mathematical Department Fund	250.00	
Students' Deposits	500.00	250.00
Notes Payable	150,000.00	120,000.00
M.I.T. Stock Account	682,401.19	681,976.15
	$1,769,771.95	$1,798,763.47
Increase		
Consisting of: —		
Bequests for Special Purposes, etc. See page 76		10,136.60
Gifts and Bequests for General Purposes. See page 76		50,196.21
		60,332.81
Less Notes Payable Paid	30,000.00	
" Biological Instrument Fund used	356.50	
" Mathematical Department Fund used	250.00	
" Letter-box Fund used	59.75	
" Students' Deposits	250.00	
" Expenses more than Income	425.04	
		31,341.29
		$28,991.52

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,942.00	From Dividends, Bank Stocks	1,154.80
" " Scholarships	6,400 00	" State Tax returned on Bank Stocks	237.21
" " " James Savage Fund	400.00	" Bonds	9,470.17
" " Charlotte B. Richardson Fund	1,682.04	" Dividends, Railroad Stocks	3,098.00
" " Rotch Prize Funds	450.00	" " Coal and Gas Stocks	2,305.00
" " Library	540.00	" " Manufacturing Stocks	966.00
" " General Purposes	9,196.43	" Real Estate Stocks	738.00
" " Increase of Funds	1,525.36	" Interest allowed on Funds not in Bonds and Stocks (@ 4½%	6,662.05
" " Advances to Bond Premiums	495 40		
	$24,631.23		$24,631.23

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	9,814.00	Received Income from Railroad Bonds	10,314.00
Credited to Advances Bond Premiums	500.00		
	$10,314.00		$10,314.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		150 00	
State Board of Health, for use of Laboratories		375.00	
Land and Building, Clarendon St., on account		8,250.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will	1,000.00		
less Tax	357.33		
	1,357.33		
		842.67	
Use of Rooms and Gymnasium		1,177.75	
Mass. Ave., Cambridge		366.66	
		16,462 08	
less Tax and Repairs, Cambridge		1,187.85	
			15,274.23

Department Supplies.

Chemistry	9,286.58	
Physics	6,723.37	
Mining	1,613.07	
Mechanical Engineering	2,789.82	
Naval Architecture	571.24	
Applied Mechanics	1,766.09	
Civil Engineering	2,931 04	
Biology	1,242.73	
Geology	778.50	
Architecture	2,062.25	
Drawing	55 16	
Mathematics	135.63	
English	1,180.30	
Workshops	1,767.91	
Modern Languages	43.32	
Periodicals	1,707.64	
Military	230.67	
		34,885.28

Salaries.

Instruction	183,337.99	
Administration	20,393.24	
Labor	19,013.19	
		222,744.42

Repairs.

Department Improvements: —		
Chemistry	1,376.11	
Mining	541.93	
Physics	471.04	
Workshops	419 29	
Mechanical Engineering	254.64	
Civil Engineering	161.95	
English	156.40	
Architecture	109.18	
Biology	92.93	
Applied Mechanics	85.89	
Geology	30.28	
Naval Architecture	22.54	
Drawing	17.50	
Military	13.37	
Mathematics	11.75	
		3,764.80
Rogers Building		2,423.49
Sundries		1,278.39
Walker Building		1,249.46
Steam Fitting		935.65
Boilers, Tools, etc.		837.49
Architectural and Engineering Buildings		580.15
Gymnasium		163.14
		11,232.57

General Expenses.

Stationery and Office Supplies		1,844.27
Fire Insurance		1,726.96
Postage		1,310.00
Hawley Furnace		1,200.00
Electric Wiring		1,144.39
Washing		759.63
Diplomas		752.85
Entrance Examinations		716.09
Sundries		608.01
Janitor's Supplies: Brushes, Pails, etc.		482.55
Express Charges, Teaming, etc.		414 88
Furniture		378.67
Paints, Varnish, etc.		375.07
Glass		286 48
Examination Books		281.25
Engine Room Supplies: —		
Oil	184.08	
Cotton Waste	61.03	
Sundries	30.24	
		275.35
Ice		273.54
Window Shades		217.31
Vacuum Pump		212.85
Lowell School of Design		193.32
Books, Supplies, etc., for General Library		158.73
Water-Pipe (Street)		150.00
Type-writing Machine		112.86
Gymnasium Supplies		92.68
Telephone & Telegraph Co.		77.33
Union Deposit Vaults		50.00
Western Union Telegraph Co.		27.00
		14,122.07

BOSTON, December 6, 1897.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1897, has been made by E. A. Stone, an accountant employed by this committee. Mr. Jackson and Mr. Tolman, the members of the committee on that date, have verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN, } *Members of the*
WILLIAM L. PUTNAM, } *Auditing Committee.*

[The absence in California of Mr. Jackson prevents his signing this report.]

BOSTON, December 6, 1897.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1897, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances, and the same agree with the Treasurer's report, as printed.

Yours truly,

EDWIN A. STONE,
Accountant.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 14, 1898.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1899.

Members of the Corporation.

President.
JAMES M. CRAFTS.

Secretary.[1]
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.
WILLIAM ENDICOTT, JR.
AUGUSTUS LOWELL.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
ELIOT C. CLARKE.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
ARTHUR T. LYMAN.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
THOMAS GAFFIELD.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
SAMUEL JOHNSON.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.

On the Part of the Commonwealth.

HIS EXCELLENCY GOV. ROGER WOLCOTT.
HON. WALBRIDGE A. FIELD, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

[1] Communications should be addressed to the Secretary of the Institute.
(See page 16.)

Committees of the Corporation.

Executive Committee.

JAMES M. CRAFTS. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }
THOMAS L. LIVERMORE. ALEXANDER S. WHEELER.
AUGUSTUS LOWELL. HOWARD STOCKTON.
FRANCIS H. WILLIAMS.

Finance Committee.

WILLIAM ENDICOTT, Jr. CHARLES C. JACKSON.
DAVID R. WHITNEY. NATHANIEL THAYER.
SAMUEL JOHNSON.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Committee on the Lowell School of Industrial Design.

PERCIVAL LOWELL. JOHN D. RUNKLE.
WILLIAM H. LINCOLN.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

AUGUSTUS LOWELL. DAVID R. WHITNEY.
HOWARD STOCKTON. GEORGE A. GARDNER.
HOWARD A. CARSON.

Trustees of the Museum of Fine Arts.

JAMES M. CRAFTS. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. ELIOT C. CLARKE.
CHARLES F. CHOATE. DESMOND FITZGERALD.
JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
DESMOND FITZGERALD. JAMES P. TOLMAN.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. DESMOND FITZGERALD.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

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SAMUEL CABOT. THOMAS GAFFIELD.
FRANCIS BLAKE.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Corporation of the Massachusetts Institute of Technology:

The past year has been to our Institute an *annus mirabilis*. The Treasurer's report shows an accession of $928,000 to the general funds of the Institute, and of $46,000 to the scholarship funds, and lately we have news of a legacy of $400,000 for the aid of scholars and teachers.

The Pierce Building has been built and made ready for occupation this autumn, and on the other hand we have suffered loss by fire in the adjoining building.

Death has removed one of the original charter members of the Corporation, and also a veteran friend of the Institute who long served on its finance committee.

The funds mentioned above are:

Estate of Henry L. Pierce	$750,000 00
" " Julia B. Huntington James	140,500 00
" " John W. Carter	6,250 00
" " John Foster	10,000 00
" " Susan E. Dorr	1,482 78
Gift from George A. Gardner	20,000 00
For scholarships:	
Estate of Ann White Dickinson	40,000 00
" " Willard B. Perkins	6,000 00

The confidence which the donors have displayed by making no restrictions upon the use of gifts is gratifying evidence of their trust in the wise administration of our school, and it greatly helps our endeavors to meet the pressing needs of the day.

The fact that Mr. Edward Austin's very generous bequest of $400,000 was made without solicitation, and that the donor had no immediate connection with the Institute, may be taken as a proof that the recognition of our usefulness is becoming more widespread in the community. For many years Mr.

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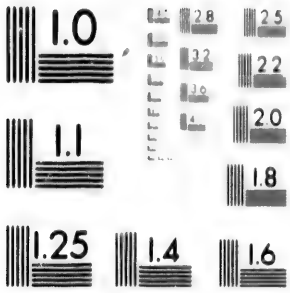


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

24:1

Austin had been in the habit of rendering pecuniary assistance to students whom he thought worthy, and, at the age of ninety-four, set aside by will a large share of his property to be employed forever in aid of education. The will provides that the interest shall be paid to needy and meritorious students and teachers, to assist them in the payment of their studies.

In consequence of this bequest the proportion of income devoted to scholarships will be increased relatively to that available for general purposes, and we believe that ample provision is now made for the probable needs of young men who are unable to pay tuition fees and who at the same time are properly fitted to receive our education.

The chief desideratum for the immediate future is an augmentation of the funds for general purposes to aid in the continued progress of the school, and the introduction of higher branches of industrial and scientific education. Some details upon these points will be given later, but it is appropriate to say here that this progress increases the cost of education, which has already risen to sixty per cent. more than the tuition fee, and that by so much all students of the Institute are assisted by the gifts in land and money of the general government, the State, and private individuals. It is apparent, therefore, that the accession of a large number of students in consequence of scholarship endowments makes necessary a large increase of income from unrestricted funds to meet the added charge. The eventual destination of all funds is similar to that of the scholarships, and the chief distinction lies in the restrictions imposed upon the use of the latter.

The Pierce Building has increased the floor space devoted to laboratories and recitation rooms by about 25 per cent.; the addition has proved very useful, and it is hoped that for some time to come no important changes will be necessary in the quarters allotted to the departments which have been moved.

It is worthy of note that the numerical increase of late years which has called for additional accommodations has been rather in the instructing staff then in the total number of students.

If our position in respect to the number of students were isolated, the fact would be discouraging, but this is not the case, for although the number of engineering schools in this and in other countries is rapidly increasing, the total number of their students has not increased, and in most cases has notably decreased. Taking the available statistics for the technical institutions of this country, we find the numbers increasing by 10 to 20 per cent. per annum till they reach a maximum in the year 1894–5, and since then a decrease of about 5 to 10 per cent. Our numbers have not fallen off in the same measure, but the increase has been much less rapid since 1893–4, and for the last five years there has been little change.

During the same period since 1894 nineteen additional instructors have been appointed in consequence of an advance, not in numbers, but in the character of the studies. This progress has been due in part to higher entrance requirements, but even more to the greater expansion which has been given to laboratory work. Experimental work of a high order exacts ever more and more a special preparation on the part of teachers and a greater subdivision of classes.

It is scarcely necessary to explain that this movement is in the direction of increased expense, and we find each year that the ratio between the cost of education and the tuition fee is continually growing on the debit side. Yet each year's experience confirms us in the stand that we have taken regarding technical education, and makes us believe more firmly in the ability of laboratory work for giving a professional man those qualities of originality, readiness, and fertility of resource in dealing with practical problems, which prove of immediate value when he enters upon an industrial career. It is often thought that these qualities are formed

later, but in many respects problems of school work, especially chosen for that purpose, are more fitted for developing and testing character than those of after life, and during school years a student can always feel assured of just ranking and friendly appreciation, while afterwards amid the rivalry of a business career he often has occasion to perceive that success is not always proportioned to unassuming merit.

It is unnecessary to present an argument against the view that theory can best be taught in the school and practice in the field, the office, or the workshop; because, even if this were true, an industrial school would not fulfil its mission by sending young theorists to be accepted or rejected after trial in the office or manufactory. It is our business to test the capacity of young men on the practical as well as the theoretical side, and to make our diploma as far as possible a guarantee of fitness to enter immediately on a career of professional usefulness.

Nothing is harder to predict, and nothing is easier to test, than the capacity of a young man for observation, experiment, and original work. We are obliged to reject many of those who wish to pursue technical studies in our school, and experience shows that the necessary qualities are exceptional rather than common in the student of good ability who comes from preparatory schools to college. Whether a different scheme of preparatory studies would give widely different results is an interesting but unsolved problem. A student does not become a skilled mechanic in our workshops, nor does he often make original investigations of great value in our laboratories, but he is given an opportunity to show what he may hope to do in after life, and we often have the satisfaction of finding that education by observation and experiment is capable of developing faculties which would not otherwise be called into exercise.

The progress in the direction indicated should be continued, and as a next step it is earnestly desired that means shall be found to enlarge the sphere of usefulness of the de-

partments of industrial chemistry and of electrical engineering and physics. Museum rooms for the exhibition of our valuable collection of products, of apparatus, and of models would be of use to the school and of interest to the public. Teaching and entertainment by evening lectures could be still further extended were a suitable building and fund for maintenance provided. Increased laboratory accommodation for machinery in motion and for electrical experiments would be of use not only to these departments, but also to the whole school, and the manner of such usefulness is strikingly set forth by the details of the report from the department of electrical engineering and physics. During last year seven hundred and ninety-two students pursued leading branches of study in this department, and the report shows how these studies form essential features of almost every course given at the Institute.

It is believed that the true policy of the Institute for the present is to turn our attention chiefly to raising the standard of instruction and providing better and larger accommodations in anticipation of having these improvements followed by an accession of the numbers who will come to us for professional education. All the information which we can collect regarding the demand for highly trained scientific professional men leads us to think that it is increasing, and where one such man enters upon the management of an enterprise which before was in untrained hands the results soon lead to calling for more men to build up a scientific staff. In all the branches of manufacturing and engineering business and in architecture the same tendency is now manifest which has long existed regarding the legal and medical professions: a tendency to confide to trained hands business which was formerly done by every one without special preparation.

Some details regarding the new building may be of interest to the Corporation. The Executive Committee voted to give it the name of Henry L. Pierce, in commemoration of his munificent bequest.

It adjoins the former Architectural Building on Trinity place, and the façade continues the design of that building, gaining in dignity by increased dimensions. It was erected according to the plans and under the supervision of Professor Homer as architect, and Professor Woodbridge for heating and ventilation. Professor Lawrence was given charge of the calculations for the iron structure, and was greatly aided by the counsels of Professors Swain and Lanza. Professor Puffer made a careful study of the electric lighting system. Professor Miller undertook the supervision of the construction of boilers and machinery, and devoted much time to the superintendence of this work.

The erection of the Henry L. Pierce Building nearly completes the occupation of two sides of the lot of land on Trinity Place.

The new building is fireproof, and contains many modern improvements, some of them novel, in the equipment of the biological and industrial chemical laboratories. The architectural drawing rooms and some others are supplied with a new system of incandescent lighting by reflection from the ceiling, which is founded upon experiments made by Professor Puffer in the physical laboratory, and will, it is hoped, be especially well adapted to the trying work of architectural and mechanical drawing. Actual tests were made by draughtsmen, and two oculists kindly gave their advice.

The Pierce Building meets the call for more space so urgently made by several departments in late reports. The basement story of the old Architectural Building and two-thirds of the new one have been devoted to heavy machinery of the Mechanical Engineering Department. The remaining third of the basement has been arranged for the lunch room, which is removed from the Rogers Building to make room for the expansion of the Mining Department. The Margaret Cheney room, formerly in the Walker Building, has been given more space on the second floor of the Pierce Building, and the

Geological Department has been removed to this floor from the Rogers Building. The third floor is chiefly occupied by the Biological Department, which had long outgrown its quarters in the Rogers Building. The remainder of the Pierce Building, besides some general recitation rooms, is occupied by the Architectural Department and the industrial chemical laboratories. Their needs have been studied with care, and the special reports of these departments will speak of features of the installation which are particularly worthy of attention.

The engine-house has been enlarged, and provision has been made for all the boilers and machinery which will in the future be required for warming and lighting the series of buildings which may be placed upon the land in Clarendon street now owned by the Institute. Two additional boilers, together with engines and dynamos of 250 horse-power, have been put in this summer for the use of the present buildings. It is good economy to join the warming and lighting appliances, and a notable saving in running expense can be made in that way, but the expenditure of capital upon the purchase of the plant is very large and forms a considerable percentage of the cost of a modern building. The upper story of the boiler house and machinery building, with a good light from above, forms an excellent modelling room for the Architectural Department.

The removal of the Biological and Geological Departments from the Rogers Building has made it possible to meet the want, long felt, of a suitable library for general purposes, and a reading room which can be kept open at all times for the use of students. A fine room occupying the whole of the north side of the Rogers Building has been fitted up for these purposes, and the English Department with its library occupies adjacent rooms. Considerable enlargements of the Secretary's and Bursar's rooms have been made, and Huntington Hall has been repainted and upholstered.

On the twenty-eighth of April a fire occurred in the ceiling

of the life class room of the Architectural Building, and much damage was done to the upper stories of that and of the Engineering Building. The material loss was covered by insurance, but such an accident to the appliances of our crowded buildings was a serious interruption to the work of the school. Energy and good will on the part of teachers and students soon extemporized means for resuming the greater part of the exercises, and fortunately the rooms burned contained no valuable machinery or apparatus. The irreparable disaster of damage to the architectural and engineering libraries was averted by the quick removal of the books and plates by the assistant librarians, instructors, and students, who neglected personal property in the drawing rooms to save the library. The government of the Institute has reimbursed private losses, since they were only in small part covered by the insurance.

The President of the Worcester Polytechnic Institute made a kindly offer of use of rooms, but it was not necessary to avail ourselves of it.

Plans of the Pierce Building and of the ground floor of the Engineering Buildings devoted to Mechanical Engineering are to be found at the end of this report.

The members of the Corporation, whose loss by death has been referred to, are Frederic W. Lincoln and John M. Forbes.

Mayor Lincoln was a charter member of the Corporation. His services began in 1861, and have lasted thirty-seven years, until the date of his death, Sept. 13, 1898. He was at various times a member of the following standing committees: the Society of Arts, the Museum of Industrial Arts, the School of Industrial Science, the Museum of Fine Arts, the Departments of Modern Languages, of Literature, History, and Political Economy, and also a member of nearly all the special committees charged with transacting the current business of the Corporation. He never regarded his duties as perfunctory, but was always present when possible, and ready

to place at the service of the Institute his sound judgment and great experience with men and public affairs. His long connection with our body will always be held in affectionate remembrance.

The death of Mr. Forbes has followed closely upon that of his son, and we have lost the powerful support of men who were leaders in the community. It is proper to speak here only of the points in Mr. Forbes' varied and successful career which touch upon the work of this Corporation, although we had reason to think that the wide sphere of his remarkable activity enhanced his usefulness to our Institute. His gifts have been large and timely, beginning in 1864 and continuing till 1894. President Rogers was in close relations with him from early days, and regarded him as a devoted friend and benefactor of the Institute. He was a member of our finance committee from 1866 till the time of his resignation in 1892, and it is needless to recall that this period was one of difficulty and financial embarrassment, when the duties of the committee were onerous. We look back with gratitude upon the services rendered by his liberality and by his financial talent.

Since I made my last report two important negotiations have taken place which are interesting from the nature of the questions involved, although they have not led to material results. One was with Harvard University, and the other with the United States Naval Department.

A letter was addressed from the Corporation of Harvard College to the Chairman of our Executive Committee asking for a conference. A committee of five was chosen at a meeting of our Corporation, and they held conferences with two members of the Harvard Corporation during the summer and autumn of last year. Your committee reported results to you at your stated meeting, March 9, 1898, and I will briefly recapitulate the substance of this report. The question under discussion was the possibility of avoiding a duplication of courses of instruction in industrial science in the

two neighboring institutions. The desirability of this end was recognized by both committees, and finally the terms of a proposed agreement were signed by all the members in conference, with the understanding that they would be submitted to the Corporation of Harvard College, as a first step toward further action.

The proposal for agreement provided for the transfer to the Institute of Technology of the courses in Civil, Electrical, Mechanical, and Mining Engineering, Metallurgy, and Architecture, now given at Harvard, as well as the use of the income from certain funds destined to the support of these courses. It was provided that the five Fellows of Harvard College should have a place among the fifty members of the Corporation of the Institute, and that two of them should be added to the present seven members of its Executive Committee, making a committee of nine. The presence on the governing board of the Institute of the above-named Fellows of Harvard College was in consequence of the use of funds belonging to the University, and of the alliance of the two bodies for the purpose of technical education. No further change in the form of government, and no changes of title or of independence of action on the part of the Institute were agreed to by the joint committee.

It is impossible to give here the details of a long and friendly discussion in which the end held in view was the advancement of education and the diminution of undue rivalry; but in order to understand the eventual failure to carry out an agreement it is necessary to say that the University Committee put forward the view that the charge of technical studies properly belongs with a university, and that a union, however slight it might be, between the University and the Institute, was desirable. The Institute Committee insisted upon the absolute independence of its government, and believed that condition to be most favorable to the free development of studies in a school of applied science. Our committee also called attention to the local situation, which

renders it unnecessary to duplicate in Cambridge studies that have been long established at Boston, and we believe that this view should receive due consideration, even although under other circumstances it may be the mission of a university to direct schools of engineering and allied professions.

The proposal for agreement signed by the Conference Committee was returned with the assent of the Harvard Corporation, but accompanied by conditions which modified its character, and which looked in the end to the establishment of a closer union. The Institute Committee were unable to see the possibility of making a promise regarding the future, and it will be remembered that they reported to the Corporation at the meeting of March 9 that no decision requiring action had been reached. Their report concludes with the following words:

"Although the result has disappointed our expectations, we still feel convinced that as friends and earnest promoters of instruction we can so direct the course of our respective institutions that they shall mutually help one another and avoid duplication of work.

"It is possible that such a result may be better attained by a friendly interpretation of our common purpose than by any attempt at a formal agreement.

"Your committee are encouraged in this hope by the very friendly acknowledgment of their reply to the Corporation of Harvard, which reads:

"'At a meeting of the President and Fellows of Harvard College, in Boston, January 31, 1898, a communication from the Committee of Conference on the part of the Massachusetts Institute of Technology was received and placed on file.

"'Voted to send the following communication to the committee:

"'The President and Fellows regret that the alliance with the Massachusetts Institute of Technology, proposed by them in a communication dated April 12, 1897, has failed.

"'The President and Fellows cordially recognize the friendly

spirit of the letter of the Committee of Conference of January 10, 1898, and will at any time meet the authorities of the Massachusetts Institute of Technology in consultation, for the purpose of avoiding unnecessary duplication of instruction.'"

The second matter upon which I have to report should not properly be called a negotiation. The initial action by the Institute was taken upon receipt, July 26, of a letter from an officer of the United States Navy, stating that the Secretary of the Navy had under favorable consideration a plan for educating the naval constructors at the Institute, and a desire was expressed for a consultation on the subject. Professor Peabody took a very active part in the matter, and views were interchanged regarding the appropriate studies for a three years' course in Naval Construction, and particularly the building of warships, to be taken by certain graduates from the Naval Academy at Annapolis. The next step followed upon receipt of a letter, dated August 17, from the Chief Naval Constructor, Commodore Hichborn, stating that he was instructed by the Secretary of the Navy to ask the Institute to submit for his consideration a scheme for the technical education of naval cadets assigned to the Corps of Naval Constructors. The immediate presentation was requested of a draft of a course which we would recommend for this object, and which could be at once begun at the Institute of Technology. The question was considered by the Faculty, and, after some further consultation with members of the Board of Naval Constructors, a programme of studies was sent to Commodore Hichborn early in September. Captain Dickens, of the Board of Navigation, was ordered to visit the Institute September 20. He saw the Secretary and Professor Peabody. As it was in vacation, and no notice was given of his coming, the other members of the Faculty were absent, and the models and appliances for the course in Naval Architecture were packed for removal to the new building. Captain Dickens reported September

22 to the Naval Department, and portions of the report appeared in the newspapers September 30. I was only able to learn from the Naval Department on October 29 whether the citations from the report were correct. Certain misconceptions and the following extraordinary passage in the report led me at first to think that the newspaper version was incorrect, but the copy sent me by the Naval Department shows that the newspapers were well informed. The passage alluded to states that "there is no method by which students can be kept up to their work by any means of discipline at the disposal of the Institute." The writer of the report, after stating what he understands to be the views and practice of the Institute regarding the course in Naval Architecture, advises the government to establish a post-graduate course at Annapolis. I have since been informed that the Naval Department has deferred a final decision upon this matter, and that meanwhile the post-graduate studies in Naval Architecture will be carried on at Annapolis.

It is interesting to note that here, as in the negotiations with Harvard University, we take the ground that any branch of technical education is intimately associated with the general scheme of work in an industrial school, and that the traditions and plans of education of such a school are necessarily of slow growth, and that the best conditions for such growth are favored by the independent existence of a governing and educational staff devoting their entire attention to a special educational problem. In the instance before us we contrast a plan to form at Annapolis classes of three to five graduates, and for the detail of a certain number of officers to give a course of naval construction, which shall be added as a post-graduate study to a naval academy, with the programme which we offered to the Naval Department. The latter treats the question as a part of a general engineering problem, which can only be solved to the best advantage in a large engineering school. Our proposed plan of studies brings the students under twenty-five teachers,

each competent and interested in some special branch, and it may be added that in the work accessory to their strictly professional studies the small class of naval constructors would have found themselves in contact with students, as well as with teachers, who were looking to the professional application of the branches which for naval construction are accessory, such as electrical or sanitary engineering, etc. Each class of students in a large school contains a group of young men who intend to make the study in question their life's work, and who inspire the others with some share of the spirit of intelligent application which springs from a foresight of the advantage that a thorough knowledge of the study will afterwards bring in their professional work. Much of the success of a technical school depends upon the propagation of this spirit.

American Association for the Advancement of Science.

In the spring of 1897 the Corporation and the Faculty united with other colleges and learned societies in extending an invitation to the American Association for the Advancement of Science to hold its 50th anniversary meeting in Boston. This invitation was accepted and the meeting was held at the Institute, August 22 to 27, Professor Sedgwick being Chairman of the Local Committee of Arrangements and Professor Tyler Local Secretary. Although the reconstruction work in the Rogers Building could not be completed before the time of the meeting, the work was so well advanced that all needful rooms were made available. The attendance was very large, and much cordial appreciation was shown of the courtesies extended to our visitors.

Omaha Exposition.

The exhibition made by the Institute was a partial one. We supplied photographic and other material for the use of

the United States Commissioner of Education in the collective exhibit of the land-grant colleges, and a distinct Institute exhibit was made in the mining building. The cordial cooperation of two of our graduates in Omaha, Mr. Earl W. Gannett of the class of 1889, and Mr. Arthur S. Rogers of the class of 1894, enabled us with a very small outlay to make an exhibit of value in the gallery of that building. Photographs and other material illustrating the work of the Mining Department were naturally made prominent, but were supplemented by architectural designs, and by a liberal supply of publications. At the close of the exposition the Institute was awarded a gold medal for its exhibit. It may be added that the exposition from an architectural standpoint was largely the work of Institute men, including the architects-in-chief, Messrs. Walker and Kimball, and several of their associates.

The Libraries.

The total number of accessions is 3,261. Of these, 1,197 were obtained by purchase, 703 by binding periodicals and books received in parts, and 1,361 by gift and exchange. After making deductions for books counted twice, for those lost, etc., the total net increase is found to be 2,696 volumes and 516 pamphlets, so that at the end of the period covered by this report the libraries of the Institute contained a total of 46,711 volumes and 14,121 pamphlets and maps.

The expenditures for the year on account of the libraries may be summarized as follows:

Books and binding	$3,783.34
Periodical account	1,466.28
Expense account	176.59
Total	$5,426.21

Details in regard to the increase in the several libraries, and the expenditures of the departments on this account, are given in the following table. The arrangement of the items in this table differs somewhat from that given in the table

of last year, on account of the transfer of the libraries of English Literature, Modern Languages, and Military Science to the General Library.

TABLE OF NET INCREASE, 1897–98, SHOWING COST OF SAME, AND TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1898.

LIBRARIES.	NET INCREASE.		Cost Departments.	TOTAL CONTENTS.	
	Volumes.	Pamphlets.		Volumes.[1]	Pamphlets and Maps.[2]
General Library. General	207	173	$47.80	4,005	3,423
General Library. English Literature	99	1	145.91	2,372	37
General Library. Modern Languages	29	18	91.69	594	18
General Library. Military Science	38	6	32.90	136	6
Totals General Library	373	198	$318.30	7,107	3,484
Architecture	195	15	446.59	2,225	200
Biology	121	30	203.73	2,071	404
Chemistry	272	38	379.19	7,228	1,515
Engineering (C.E., M.E., & N.A.)	640	55	899.06	7,922	3,374
Geology	73	13	103.46	1,838	818
Mathematics	108	50	151.82	648	163
Mining	151	18	151.29	2,054	341
Political Science. (Econ. & Hist.)	448	79	527.82	9,008	3,120
Physics	315	20	602.08	6,011	689
Margaret Cheney Room	.....	.....	.....	599	13
Totals	2,696	516	$3,783.34	46,711	14,121

The enumeration of pamphlets in this table does not fully represent the wealth of the libraries in that form of literature. In the Physical Library there is a large number of pamphlets, which were catalogued by the assistant in charge during the last year, but they do not appear in the table because they have not been entered in the record of accessions. Also in the Chemical Library there are many reports of state boards of health, bulletins of agricultural experiment stations, and

[1] Including volumes of collected pamphlets.
[2] Including pamphlets bound together in volumes.

the like, in pamphlet form, which require considerable attention from the Librarian, occupy space, and are of a certain amount of use, but which will not appear in the tables until they are collected together in volumes and bound.

Some of the data usually given to show the amount of work done in the Library may be presented in the form of a table as follows:

Number of orders given for the purchase of books	1,349
Number of order-slips found to be duplicates and returned to heads of departments	173
Number of these reordered	5
Foreign books received for inspection	139
Number of these purchased	60
Orders for binding and lettering	1,053
Cards added to the main catalogue	2,469
Total number of cards in the main catalogue	42,142
Books borrowed from the Chemical Library for home use	3,169

Unfortunately the Chemical Library is the only one in which a record has been kept of the use of the books. Here the proportion of borrowings to the total number of books is high, about 2 : 7, but it is probable that this would be found not to be much above the average of the other libraries. The system of suggestions for purchase is continued as heretofore, with good results. Every week the American, English, French, and German lists are read over, and any title which appears likely to be of interest to any department of the Institute is brought to the attention of the head professor by means of a "Suggestion for purchase." A large proportion of these have been accepted, but no record was kept of the number.

The clerical force of the Library has reached a state of efficiency never before realized, and the Librarian is enabled to do the work more effectively than heretofore. It has been said that two of the most important libraries of the Institute were seriously threatened by the fire in the Engineering Building, and one of them, the Architectural Library, would

have suffered very serious damage, if it had not been for the prompt work of the students in the building. We cannot give too much praise to these students, who showed such practical loyalty to the Institute, and to Miss Loring, assistant in charge of the library, who coolly stayed upon the scene and directed the work until every book had been removed to a place of safety.

The end of this year marks the beginning of a new epoch in the history of the Library. Heretofore the General Library was simply the office of the Librarian, and incidentally served as a study for first-year students, and a place to store odds and ends that could find no place in the departmental libraries. Now the General Library has been removed to the large room formerly occupied by the biological laboratory. The room has been entirely remodelled, decorated, furnished in mahogany, and provided with electric lights. Adjoining the library is an office, where the Librarian is provided for the first time with room adequate for the work that he has to do. The books and periodicals of the Departments of English Literature, Modern Languages, and Military Science have been added to the General Library, and it is hoped this library will become more widely useful to instructors as well as to students.

Mrs. Henry Draper continues to give the Institute the "Comptes-Rendus de l'Academie des Sciences de Paris." In like manner we are receiving through the generosity of Mrs. William B. Rogers, "Nature" and "Popular Science Monthly." Mrs. Rogers has also given us a number of volumes, including two volumes of Hall's "Palæontology of New York." Among the other gifts to the Library may be mentioned: "History of the Lowell Institute," from Mr. Augustus Lowell, nine volumes on fuels and combustion from Mr. Charles F. Allen, and sixty-one pamphlets and five volumes from Professor Runkle. Professor Gill, Professor Bates, Professor Noyes and Doctor Mulliken, Professor van Daell, Professors Bailey and Woods, Mrs. Richards and Miss Maria Elliott,

and Professor Wells have each presented the Institute with copies of their published writings.

Scholarships.

The work of the Scholarship Committee of the Faculty has continued to increase, and the demand on the part of needy and meritorious students has more than kept pace with the large increase in available resources. A further payment from the estate of the late Mrs. Dickinson has recently increased our principal by $40,000, but the full income of this amount is not available for the present year. The number of applicants for Institute scholarships up to the present time has been 127, while 127 submitted applications for the forty State scholarships. Sixty-eight of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 186. Of these, 38 have received scholarships to the amount of full tuition; 86 others have received smaller amounts, averaging somewhat more than one hundred dollars each.

Last year a decision from the Attorney-General's office appeared to preclude the further division of State scholarships in halves. As such division had made it possible to assist a much larger number of applicants to the extent needful, representations were at once made to the Legislature, which led to the enactment of a supplementary act authorizing division for the future.

Attention was called in the last report to the fact that repayment had not been made to the desired extent by past beneficiaries of the Rogers Fund. In view of the fact that returned amounts become immediately available for use as income, it seemed especially important to the committee that some improvement should be effected. Notes were accordingly sent by the Chairman of the Alumni Committee to those persons whose indebtedness was of somewhat long standing, and more than $300 has been returned for the immediate use

of the Scholarship Committee. It is hoped that many such returns will be made in the future.

Graduate Scholarships.

The graduate scholars of the current year are Messrs. D. W. Edgerly, of the class of '98; W. T. Keough, of the class of '88; E. S. Manson, Jr., of the class of '97; G. P. Stevens, of the class of '98; and C.-E. A. Winslow, of the class of '98. Of these Messrs. Edgerly, Stevens, and Winslow are candidates for the Master's degree; Mr. Manson received that degree last year; Mr. Keough is taking special work in naval architecture. By the generosity of Mr. Augustus Hemenway, Mr. Winslow receives a scholarship of $400, and will be designated in the catalogue as Hemenway scholar.

Fellowships.

The Swett fellowship is retained by Mr. William David Coolidge, of the class of 1895. Mr. Coolidge's work in Leipzig has been so successful that he has received an appointment as private assistant to Professor Drude for the current year.

Mr. Wendell, who had held the Savage fellowship for two years, not having renewed his application, the fellowship has been transferred to Mr. George K. Burgess, of the class of 1896, who has been for the last two years Assistant in Physics. Mr. Burgess is now engaged in advanced studies at Paris.

Mr. Herbert William Chamberlain, of the class of 1895, was also an applicant for a fellowship, and it was with much regret that the Faculty found itself unable to assist him. He has, however, in recognition of his attainments and the merit of his plans for work abroad, been appointed a Fellow without pecuniary aid, and Mr. Wendell's name has also been retained as an honorary Fellow. It is believed by the Faculty that advanced work by our graduates under the general

direction of the Faculty may well be recognized in this manner.

Military Science and Tactics.

Captain Bigelow was called to active service shortly before the expiration of the time of his detail, and I desire to express our regret at the termination of his connection with our Institute. We are indebted to his initiative for the excellent footing upon which the military instruction has been placed, and to his zeal, untiring interest, and good judgment as a member of the Faculty in conducting these studies in harmony with the general policy of the school. It was impossible, on account of a decision of the War Department, to secure the detail at present of an officer on the active list, nor did we succeed in obtaining the appointment of a retired officer of the regular army, but we have secured the services of Captain John Bordman, Jr., Battery A, 1st Massachusetts Heavy Artillery, who has been appointed military instructor for one year.

Captain Bordman entered service in 1888; held commission in Harvard Rifles and studied military science at Harvard University, from which he holds degrees of A.B., 1894, and LL.B., 1897. He specialized in American history, taking highest second-year honors, and honorable mention twice. He performed active service when his regiment was mustered into the United States volunteer army.

The instruction in military science and tactics has proved of immediate advantage to certain of our students during the last summer, when the volunteer army was mustered into service.

A long continued correspondence with alumni and with special students who have followed courses at the Institute has given us the names of seventy-five who were engaged in the military service of the United States during the recent war with Spain, but some names are still wanting.

The following lists commemorate the names of these men:

Members of undergraduate classes who entered the United States service:

Adams, H. H., '99, engineering work at Fort Warren.
Borden, Raymond D., 1902.
Bowditch, Ingersoll, 1900.
Boyle, John, Jr., 1901.
Dodge, Lyman E., 1901.
Hasbrouck, R., '99.
Hitchcock, Albert W., '99, 2d Massachusetts Regiment.
Kendall, Frederic M., 1900, Sergeant, 6th Massachusetts Volunteers.
Little, James L., Jr., 1900.
Miller, Stuart B., 1900.
Patch, Claude E., 1901, 6th Massachusetts Regiment, Acting Bugler.
Pierce, Reginald K., '99, Troop A, N.Y.
Robson, Edward R., 1900, coast defence.
Snelling, Howard, '99.
Stevens, F. B., 1900, coast duty with Cadets.
Taylor, Denzil H., '99, Company A, 6th Regiment.

Former students serving in the Regular Army during the war with Spain:

Borup, Henry D., '84. Graduate of West Point, Lieutenant, U.S.A.
Füger, Frederick W., '91. 1st Lieutenant, 13th U.S. Infantry.
Haines, John T., '85. 1st Lieutenant and Quartermaster, 5th Cavalry, U.S.A.
Lyle, David A., '84. Graduate of West Point, Captain, Inspector of Ordnance, U.S.A.
Osgood, Henry D. Private, U.S.A.
Ripley, Henry L., '73. Captain, 3d Cavalry.
Russell, Andrew H., '68. Graduate of West Point, Inspector of Ordnance.

Weston, John F., '85. Graduate of U.S. Artillery School. Brigadier General, U.S.A.

Former students serving in the Volunteer Army or Navy:

Alden, Charles H., Jr., '90. Corporal, Company D, 1st Corps Cadets, M.V.M.

Allen, William H., Jr., '97. 1st Corps Cadets, M.V.M.

Ames, Azel, '95. Captain, 1st Regiment, U.S. Volunteer Engineers.

Ames, Butler, '96. 1st Lieutenant, Light Battery A, until May, '98. Resigned to accept Adjutancy of 6th Massachusetts Regiment. Appointed Lieutenant-Colonel.

Appleton, Charles B., '84. At Camp Dewey, on the Provost Guard.

Atwood, Thomas C., '97. April, '98, Naval Brigade, M.V.M. June 16, '98, enlisted U.S. Navy. Sept. 5, '98, honorably discharged from Navy. Served on gunboat "Inca," as gunner's mate.

Bemis, Albert F., '93. Company A, 1st Corps Cadets, M.V.M.

Borden, Charles N., '89. Sept. 30, '92, Naval Brigade, M.V.M. Nov. 1, '92, appointed Petty Officer. March 9, '98, received commission as Ensign, U.S.N. Sept. 16, '98, received honorable discharge from Navy. Now Ensign in Naval Brigade, U.S.N.

Coburn, Arthur S., '95. May 16, '98, machinist at Boston Navy Yard, detailed to U.S.S. "Southery."

Collins, Bertrand R. T., '88. May 24, '98, Ensign in U.S. Navy. June 2 to September 22, Watch and Division Officer, U.S.S. "Scorpion." October 22, honorable discharge.

Conant, Francis M., '96. 142d Separate Company N. G., N.Y.

Dana, Leslie, '96. Light Battery A, 1st Missouri Volunteers. Detached duty on the U.S.S. "Gloucester."

Daniell, Jere R., '97. Assistant Engineer with rank of Ensign, U.S. Navy.

DuBois, Barron P., '92. Past Assistant Paymaster, U.S.S. "Bennington."

Feland, Logan, '92, Captain, Company K, 3rd Regiment, Kentucky Volunteers.

Ferguson, John N., '94. March, '96, Massachusetts Naval Brigade.

Foster, Sumner H., '95. Captain.

Hammond, Charles F., '91. Chief Master-at-Arms, U.S.S. "Yosemite," acting May 19 to August 22, Michigan Naval Militia. August 22, honorably discharged.

Hayden, Charles, '90. 1st Corps Cadets, M.V.M.

Hewett, Joseph, '96. 1st Lieutenant, 2d Co., M.P.M.

Holton, Edward C., '88. Sergeant, Troop C, 1st Ohio Volunteer Cavalry.

Howard, Sheldon L., '98. 2d Lieutenant, 5th Massachusetts Infantry, U.S. Volunteers.

Howe, J. Wilder, '93. 2d Lieutenant, 2d Regiment of Engineers, U.S. Volunteers.

Hubbard, Chester D., '97. 1st-class Sergeant, 1st U.S. Volunteer Signal Corps.

Hunt, Alfred E., '76. Captain of Light Artillery, U.S. Volunteer Service from Pennsylvania. In camp at Mt. Gretna, Chickamauga, and Porto Rico. Service at Santiago.

Kent, William A., '97. May 15, Sergeant 1st Volunteers, transferred to 3d U.S. Volunteer Engineers. June 29, Sergeant-Major. September 12, 2d Lieutenant.

Kotzschmar, Hermann, '95. Engineer, U.S. Navy.

Lansingh, Van Rensselaer, '98. July 21, '98, U.S. Volunteer Engineers, 2d Regiment, 2d Battery, Company E, at Chicago.

Lenfest, Bertram A., '90. Company A, 6th Regiment, M.V.M.

Loomis, Henry M., '97. 142 Separate Company, N. G., N.Y.

MacClure, Colbert A., '94. June, '98, 2d Lieutenant, Company D, 17th Regiment, National Guards of Pennsylvania.

MacRae, Donald, '85. Captain of Company K, 2d Regiment, North Carolina Volunteers.

Messenger, William H., '92. Assistant Engineer, rank of Ensign, U.S.S. "Cincinnati."

Morris, Charles, Jr., '96. June, '98, U. S. Navy, as Assistant-Paymaster, U.S.S. "Hist."

Pierce, Edward L., Jr., '86. 2d Lieutenant, 1st U.S. Volunteer Engineers.

Pierce, Josiah, Jr., '86. Colonel on General Grant's Staff in Porto Rico, engineer's office.

Pope, Charles H., Jr., '97. Private.

Sears, Henry D., '87. Lieutenant in command of Company E, Massachusetts Naval Brigade.

Sears, Mortimer A., '96. May 1, '97, enlisted Denver City Troop N.G.C.

Smalley, F. N., '96, Hospital Corps, U.S.A., Manila.

Sprague, Timothy W., '87, Company B, 1st Corps Cadets.

Stearns, Frederic B., '98. With Cadets.

Stearns, Walter M., '96. 1st Corps Cadets M.V.M.

Strickland, William R., '98. May 14, '98, Assistant Engineer, U.S. Navy, relative rank of Ensign. Assigned to U.S.S. "Bennington."

Swift, William E., '95. July 20, '98, 2d Lieutenant, 20th Company Provisional Militia of Massachusetts. Aug. 3, '98, received commission.

Taylor, Edward M., '98. 1st Lieutenant, U.S. Volunteer Engineers.

Thompson, Frederic, '98. Oct. 5, '98, appointed Civil Engineer U.S. Navy, rank of Lieutenant (junior grade).

Tillinghast, Charles F., '95. April 28, '98, U.S. Volunteer Service, Rhode Island Regiment. May 10, '98, appointed Captain, Company A, 1st Rhode Island U.S. Volunteer Infantry.

Vielé, Maurice A., '86. Captain, 1st U.S. Volunteer Engineers.

Wells, Edward C., '92. Past Assistant Engineer, 2d Battalion, Naval Militia of Illinois.

Wood, Kenneth F., '94. Warrant officer with rank of Sergeant. Member of Hospital Corps Brigade of Rhode Island.

Changes in the Faculty and the Corps of Instruction.

Dr. H. O. Hofman has been appointed Professor of Metallurgy. He was made Associate Professor in 1891, after a previous connection with the Institute commencing in 1885. Born in Heidelberg, and trained in scientific studies in that university, he entered the royal Prussian School of Mines, and was graduated 1877 as mining engineer and metallurgist, and entered the government service at the Lautenthal Smelting Works in the Harz Mountains. In 1881 Dr. Hofman came to America and engaged in metallurgical work, being employed in Pennsylvania, Missouri, Kansas, Colorado, and Mexico. His thorough acquaintance with European and American metallurgical processes has been of great value in his teaching, and his text-book, referred to elsewhere, makes him a recognized authority on these subjects.

Dr. Henry P. Talbot has been appointed Professor of Analytical Chemistry. He graduated at the Institute in 1885, and studied in Germany for two years. Since that time he has been continuously connected with the chemical department of the Institute, and after the departure of Dr. Drown he performed with great fidelity and good judgment a large share of administrative work of the chemical departments. He has charge in the laboratory and the lecture room of the large classes in analytical chemistry.

Assistant Professor Bartlett has been appointed Associate Professor of Mathematics, having served the Institute with marked success, not only as a teacher of mathematics, but in other directions, since his graduation.

Mr. Henry G. Pearson has been appointed Assistant Professor of English. He received his A.B. degree at Harvard in 1893, and was appointed Instructor in English in the same year. The Department of English has been so much strengthened in recent years that it is now able to coöperate effectively in criticism of written work of students in other departments.

Mr. James Swan, '91, after spending the summer vacation in government service at Newport News, finally resigned his instructorship in Naval Architecture to enter the employ of the Newport News Shipbuilding Company. Mr. Swan's work in the department was taken by Mr. Carl H. Clark, '95, who was transferred from the Department of Mechanical Engineering.

The following assistants have terminated their connection with the Institute:

Frederic W. Howe, B.S.,
George K. Burgess, S.B.,
Leonard H. Goodhue, S.B.,
Fred E. Busby, S.B.,
Minor S. Jameson, S.B.,
William L. Root, S.B.,
Charles N. Haskins, S.B.,
Nathan Hayward, A.B., S.B.,
Herman W. Marshall, S.B.,
Minot A. Bridgham,
Ira G. Studley,
William F. Hyde.

The following new assistants have been appointed:

Charles B. Breed, S.B., in Civil Engineering.
Joseph G. Coffin, S.B., in Physics.
William T. Hall, S.B., in Analytical Chemistry.
George M. Holman, M.D., in Biology.
Areli H. Jacoby, S.B., in Industrial Chemistry.
Carleton S. Koch, S.B., in Mining Engineering.
Alice G. Loring, in Architecture.
Joseph C. Riley, S.B., in Mechanical Engineering.
Eugene W. Rutherford, S.B., in Mechanical Engineering.
Lewis J. Seidensticker, S.B., in Oil and Gas Analysis.
Harrison W. Smith, A.B., S.B., in Physics.
Maurice De K. Thompson, S.B., in Physics.
James Francis Leary, in Forging.
Joseph Albert Frizzell, in Woodwork.
Frank Cushman, Jr., in Machine Tool Work.

Entrance Requirements.

The addition of an elective subject to our previous entrance requirements was announced in the last catalogue, and has

gone into effect this year. The information obtained through the teachers' certificates has been of much value, and the laboratory note-books have shown that work of high quality in physics and chemistry is done in not a few of the secondary schools. Next year solid geometry becomes an absolute requirement for admission, instead of an alternative, as now, with advanced algebra. The Faculty are of opinion that all secondary schools preparing students for the Institute should be able to teach solid geometry, and it is in general better for students to prepare in this subject than in advanced algebra. It will still be possible, however, for the stronger schools to teach both subjects, as they have done heretofore.

Departmental Reports.

Mathematical Department. — No radical changes have occurred in the department during the past year. The number of sections has remained unchanged, and with the present constancy of the total number of students, no increase is likely to be needful in the near future. The department has shared to some extent in the Institute expansion, gaining the use of Room 20 of the Rogers Building for its library and collection of models. Delays have occurred in the preparation of cases for this room, but it will form when finished a commodious and accessible room for instructors and advanced students. A special appropriation has been made for the purchase of needful books of reference for the library. Professor Woods is at present giving an advanced course at Harvard, the occasion being the absence for the year of Professor Peirce.

The Department of Modern Languages has been called upon this year to take its share in the work of preparation for the industrial expansion which is expected to result from the conquest of colonial possessions.

The class in Spanish has mounted from eight to fifty students. It is probable that this large increase springs from temporary enthusiasm, but it is certain that we shall be

required to provide more than hitherto for the linguistic education of our graduates who seek occupation in foreign lands. If this movement takes place, it will be a new one, for the addresses of the graduates in 1896 and in 1897 show only two names of students now residing abroad, and one of these is an alien.

Courses I and XI., Civil and Sanitary Engineering — No changes have been made in the courses of study during the past year. The occupation of part of the new building has given a much needed increase of space in this department, and there is now ample accommodation for a number of years.

The greater part of the upper floor of the Engineering Building, which was formerly occupied by the second and third year drawing rooms, is now devoted to the second year alone, the partition, which was partially destroyed by fire, having been removed. This room will accommodate over one hundred and fifty desks, and will provide for considerable growth. The upper floor in the former Architectural Building is now occupied as the third-year drawing room, and will accommodate from sixty to eighty students. The floor below, of the same size, is occupied as the fourth-year drawing room. The old fourth-year drawing room has been given up partly to private offices which had to be moved on account of the extension of the library, and the remainder is used as a model room and museum in which the various instruments, models, and specimens of the department are kept in cases where they will be easily accessible, and where they may at the same time prove of interest to visitors. More ample space, together with the construction of the geodetic observatory, enables the work of the Civil Engineering Department to be carried on to much better advantage than ever before.

The geodetic observatory, to which reference was made in my last report, was completed during the last spring. It is located in the Middlesex Fells, upon a site which is very favorable for the observations which are there to be conducted. The thanks of the Corporation are due, and have been expressed, to the Metropolitan Park Commissioners for

permission to erect the building in this location. The observatory is a stone building fifteen feet square, and has already been equipped with a number of instruments, including a break circuit chronograph, a sidereal chronometer, a transit instrument with micrometer eyepiece, and various smaller instruments. The magnetometer, owned by the Physical Department, will also be used here. A dip circle has already been ordered, and during the present year the observatory will be further equipped with a pendulum apparatus for measuring the relative force of gravity and with a large altazimuth instrument. With this equipment, the Civil Engineering Department will be able to offer superior advantages for the study of geodesy.

The property of the department has been further increased during the year by the addition of a large number of photographs and slides, and during the coming year it is expected to make this collection very complete and valuable.

The extension of the engineering laboratory into the basement of the Architectural Building affords the much-needed increase of room in the hydraulic laboratory and pit, to which reference was made in my last report.

Various excursions have been made during the past year to works of interest in the neighborhood of Boston, and thanks are again due to President Lucius Tuttle, of the Boston & Maine Railroad; General Manager W. H. Barnes, of the Boston & Albany Railroad; General Passenger Agent A. C. Kendall, of the New York, New Haven & Hartford R.R.; Superintendent of Streets B. W. Wells; Deputy Superintendent C. R. Cutter; and various other gentlemen, for courtesies extended in connection with these excursions and with the general work of the department.

Summer School of the Civil Engineering Department. — The summer school for field-work in the Civil Engineering Department was held during the month of June at Lancaster, Mass., a new location for this work. This was the eleventh summer school of this department. Sixteen stu-

dents were in attendance. Instruction was given by Professors Burton, Porter, Robbins, and Barton, assisted by Mr. McKibben and Mr. Hosmer of the instructing staff, and by Mr. H. R. Thayer of the class of '98. The work was continued during nearly four weeks. The usual practice was given in topographical field work, and in triangulation and base-line measurements, and gaugings were made of the flow of water in the two branches of the Nashua River, and also in the mill flumes in Lowell. Under the direction of Professor Barton, geological field work was also carried on. A meteorological station was established on Mt. Wachusett, and the regular records of the weather bureau were there taken. Observations were also made for time and latitude. Practice was given in signalling with the heliotrope, and observations were made on atmospheric refraction.

Course II., Mechanical Engineering. — For the last two or three years the engineering laboratories have been gradually becoming more and more crowded, until they have reached such a condition that a part of the apparatus in our possession could not be utilized, and some could not be used to the best advantage. This matter has been remedied by the erection of the Pierce Building; there has been added to the engineering laboratories the basement of the former Architectural Building and also one-half the basement of the Pierce Building, making their total floor space about 21,000 square feet.

The drawing-room No. 20, on the second floor, is now occupied by second and third year students, 124 in the first term and 171 in the second term. The drawing-room No. 30, on the third floor, is occupied by 117 third and fourth year students. Two hundred and eighty-five drawing tables are now used, and their number could be increased to 315, and a somewhat larger number of students could be accommodated because in the second year two can use one desk.

The laboratory of applied mechanics admits of experimental work with machines and apparatus for 135 students, with some margin for expansion.

The other portions of the engineering laboratories have space for about 300 students. The largest number which has yet worked in them is 243.

In the basement of the Pierce Building has been placed a McIntosh and Seymour 11-inch and 19-inch by 15-inch tandem compound engine, provided with a surface condenser and an air pump, all suitably arranged for purposes of experiment. The main drive wheels are rope wheels, and the power is taken from this engine to the main line of shafting by a rope drive. A Prony brake of 100-horse-power capacity is also placed in this laboratory. This brake was already in possession of the Institute, but could not be used for lack of room.

The 36-horse-power Otto gas engine and the rotary pump are on foundations in this room, and can now be operated at their full capacity for purposes of experiment. There is a large cistern for water, which is connected by a pipe with the cistern in the Engineering Building, thus furnishing a larger cistern capacity for water for the hydraulic experiments. The boiler-house has been enlarged, and two new horizontal tubular boilers have been added, these being fitted with Hawley down-draught furnaces. This furnishes additional opportunities for boiler testing.

Besides the improvements in the engineering laboratories, there has been added to the drawing-room space the second floor of the former Architectural Building, and a new drawing-room has been set apart for the Department of Naval Architecture, thus relieving our drawing-rooms from their crowded condition.

A new circular of the department has been issued, describing the equipment as it now exists, and containing plans of the laboratories. The following table, taken from this circular, shows the present occupations of all the living graduates from '68 through '97. It is interesting to follow the careers of those whom we have undertaken to train for industrial pursuits, and to find that ninety per cent. are now making a direct use of that training.

Professor Peabody has issued this autumn a revised addition of his "Thermodynamics of the Steam Engine." This standard text-book has undergone a thorough revision since the date of the last edition, 1889, and includes the last experimental work on the subject.

OCCUPATIONS OF THE LIVING GRADUATES IN MECHANICAL ENGINEERING, 1868–97.

Railroads, including brakes and signals	29	Lawyers and patent solicitors	6
Textile industries and machinery	30	Building materials	4
Steam-engine and steam-pump works	17	Cordage works	2
Steel and iron works	14	Contracting engineers	2
General machinery	27	Photographic materials	5
Electrical works	22	Testing laboratory	1
Ship and marine engine works	16	Astronomy and meteorology	2
Experts and consulting engineers	27	Editor	2
Experts' assistants	11	Chemist	1
Special machinery and manufactures	69	Architect	1
Teachers	36	Military	3
Mill insurance	7	Surveyor and landscape gardener,	4
Refrigerating machinery	4	Doctors	2
Paper making	4	Artist	1
Gas works	2	Farmer	1
Water and sewerage	5	In business	27
		Students	1
		No record	4
			389

The publication of the results of tests in the Technology Quarterly has been continued: No. IX. issued March, 1898, and No. X., September, 1898.

APPLIED MECHANICS. — The basement of the former Architectural Building has been added to the laboratory of applied mechanics, and in this room have been placed the transverse testing machine of 18,000 pounds capacity, the machine for testing sliding position, and the machine for testing the wear of brake shoes and wheel tires, all of which were in the other part of the laboratory, where they had not sufficient room. The two experimental governors have also been placed here.

The power is transmitted to this room from the other part of the engineering laboratories by a rope drive presented to the Institute by the Dodge Manufacturing Company.

There has been built, out of doors, a kiln for drying lumber, to allow of the study of the effect of different percentages of moisture upon full-size timber beams and columns.

SHOPWORK. — The total number of students taking shopwork is 231 (last year it was 210). Many of these take more than one course, and they are divided among the different shop departments as follows:

CARPENTRY AND WOOD TURNING,	
Courses II., VI., X., and Special Class	103
FORGING,	
Courses II., XIII., and Special Class	89
CHIPPING AND FILING,	
Courses II., XIII., and Special Class	54
MACHINE TOOL WORK,	
Courses II., XIII.	34
METAL TURNING,	
Course VI.	39
PIPING,	
Course XI.	2
	321
Students taking more than one course and counted two or more times	90
	231

The change of the shop entrance to the large central door in the front of the workshops, located on the driveway leading from Garrison street, has resulted in extensive improvements and enlargements. This entrance, which replaces the three doors previously used, now gives direct and convenient access to all of the shop departments. At the right of this main entrance a large lavatory (30 ft. × 40 ft.) has been fitted up with suitable sinks and 204 lockers. From the lavatory the students may go directly to the different departments, a partitioned passage through the carpenter shop leading to the forge shop. There can now be no interference with class work by students passing in or

out of the shops. To make room for the lavatory, the tool-room of the machine shop was moved to the west, where it is increased in size about one-third. It is now 40 ft. × 12 ft., and is more conveniently located. West of the tool room, and in the space formerly taken up in part by the entrance to the machine shop, an "instruction-room" for chipping and filing and machine-tool work has been fitted up with seats, forming an amphitheatre about an engine-lathe, speed-lathe, and chipping and filing bench. This, it is believed, will prove a great convenience and assistance in giving instruction. In the rear of this room an office has been fitted up for the instructor.

The removal of the machine-shop lavatory has made available a space about 10 ft. × 40 ft. This may be advantageously used for new machinery, which it is hoped we shall have before long. A new office has been constructed for the instructor in forging, without loss of shop room, and it has been found a great convenience when compared with previous arrangements.

Course III., Mining and Metallurgy. — This department has relinquished Rooms 36 and 37 on the third floor of the Rogers Building and has received in exchange the space recently occupied by the lunch-room. This change, together with the removal of the blowpipe work to the Pierce Building, has permitted the consolidation of the instruction to great advantage. The lectures are now all given in one room, with charts and specimens always at hand for illustration, and a much needed laboratory for mining and metallurgical tests on a small scale has been installed with desks for twenty students.

The assaying laboratory has been enlarged and now has desks for seventy-six students.

The other laboratories are arranged for the instruction of classes in sections of the following numbers:

Assaying laboratory	15
Smelting laboratory	10
Ore-dressing laboratory	10

The lavatory has lockers for one hundred students.

The room for assay supplies has been enlarged to meet the increasing demand.

Two new offices have been partitioned off, one for Professor Lodge and one for the assistants.

The collections of ores and metallurgical products have all been assembled in one room to be used as a museum, and are now being thoroughly arranged and labelled.

The Mining and Metallurgical Laboratory has been supplied with a new Root blower of greater capacity than that formerly used; with a new crucible furnace for larger crucibles and higher heats than that which it replaces; with a new chlorinating barrel for gas chlorination of gold ores; with a set of Devereux slag pots for the blast furnace; with an electric motor which will drive all the machinery in place of the engine; with a new Harz jig for concentrating ores. The crushing rolls have been newly mounted with Gates feeder and adjustments for graded crushing.

Professor Richards' book on ore dressing is nearly completed. During the year he has contributed an article on ore dressing to the Mineral Industry.

The new edition of Professor Hofman's work on lead has passed through the press and is just now coming out. This book contains a complete treatment of the processes used in America and of foreign methods so far as they interest our metallurgists, and it is a most important authority upon the subject.

Professor Hofman has written two papers on testing clays, one on coking in by-product ovens, and has contributed an article on "Lead" to the Mineral Industry.

Professor Lodge is preparing a new edition of his "Lithographic Notes on Assaying."

SUMMER SCHOOL OF MINING ENGINEERING. — The Summer School of Mining Engineering was this year held in Nova Scotia. Visits were made to mines, coke works, and furnaces; those to the mines were given the most prominence.

The party numbered fourteen, including Professors Richards and Hofman, Assistant Watts and eleven students of the second, third, and fourth years in the Department of Mining Engineering and Metallurgy. The party studied the plants and the methods of operation at the gold mines, mill and chlorinating works of the Brookfield Mining Company, Limited, at North Brookfield; at the coal mines of the Cumberland Railway and Coal Company at Springhill, of the Canada Coal and Railway Company at Joggins, and of the Intercolonial Coal Company, Limited, at Westville; at the iron mine, coke ovens, iron furnace and steel works, near New Glasgow, of the Nova Scotia Steel Company, Limited; at the coke and gas works of the Peoples' Light and Heat Company, Limited, at Halifax; and at the gold mine and mill of the Golden Group Mining Company, Limited, at Montagu.

Besides the above more strictly professional studies, excursions were made with Mr. B. B. Barnhill of the class of '73 at Joggins to inspect the geological exposures, and at Partridge Island to collect minerals occurring in the trap formation. The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest taken in the students, to whom the freedom of the works was cordially granted.

Course IV., Architecture. — The only important change in the courses of study offered by the Department of Architecture has been the introduction of the new option in Architectural Engineering. For some time it has been felt that a demand existed for men specially trained in the computation of all the details of modern steel construction, and that the regular course should be so modified that under-graduates might be allowed a choice between the academic and engineering sides of architecture. This choice is now offered at the middle of the third year, the introduction of courses in structures and structural design, in place of academic design, constituting an important addition to the engineering side of the established courses of the department. It is to be hoped

that graduates as well as under-graduates will take advantage of opportunities offered by this option.

By far the most important event during the past year has been the change to the new quarters in the Pierce Building. For the third time since 1883 the department has had to change its location in order to meet the constant need of expansion. From the small rooms at the top of Rogers it has so grown that it now occupies two and one-half floors of the Pierce Building and the large room at the top of the Dynamo Building.

The new quarters provide space for all the rooms of the former Architectural Building, and in addition give opportunity for increased accommodation for the architectural library, exhibition-room, and fourth-year and graduate drawing-rooms. The library and fourth-year drawing-room have now double the area of the old room, and the former crowding and interference have entirely disappeared. We are also to be congratulated on the fact that the library is now placed in a fireproof building where its valuable books will have proper protection. The adoption of the alcove system in the library greatly assists in the effective use of books by bringing together works of the same period and subject. The library is not only better arranged than heretofore, but also has room for the addition of some 800 quarto volumes, 250 large folio volumes, 10,000 photographs, and 12,000 lantern slides. Better table space is also provided, and many periodicals, catalogues, and plates formerly not accessible can now be placed on the shelves. In addition, an entire alcove has been devoted to the exhibition and use of books and photographs relating to the course on the History of European Civilization and Art.

The new exhibition room gives ample opportunity for the display and comparison of designs and sketches, and the continuous exhibition of students' work. It is therefore an important aid in architectural training. The new drawing-rooms are all that could be desired, and their walls are

rapidly being covered with the best examples of academic drawing and details of classic buildings. Daylight is well diffused by the special glass and light-colored walls, so that all parts of the room can be used to advantage. At present there are the following desks in the different drawing-rooms. The number which could eventually be placed in the rooms is given in the second column:

Second-year drawing-room,	37	desks;	limit	about	56	desks.		
Third-year	"	"	46	"	"	"	75	"
Fourth-year	"	"	41	"	"	"	56	"
Graduate	"	"	11	"	"	"	15	"

The new architectural studio is also a great improvement on the old room, for it now has both direct and north top light in addition to the light from the side windows. The great north skylight in this room gives a superb light for life-class work.

At present the department feels the need of large casts in order to familiarize the students with the scale and actual size of good architectural detail. The full-size models of the orders from the Theatre of Marcellus and the full-size cornice from the Temple of Concord at Rome have proved excellent aids in class work and general instruction, but more examples are needed, and it is hoped that a series of such casts from historic buildings may be obtained in the near future.

The prizes annually given to students in the department were this year awarded as follows:

Rotch prize, $100, for student graduating with greatest distinction, Mr. G. P. Stevens.

Rotch prize, $100, for special student completing course with highest standing, Mr. A. H. Cox.

Boston Society of Architects' prize, $50, Mr. E. H. Schroeder.

Boston Society of Architects' prize, $50, Mr. H. P. Richmond.

It may also be interesting to state that during the past

summer Professor Chandler has been head of the Architect's Department of the city of Boston and a member of the Fine Arts Commission; Professor Despradelle is one of the eleven competitors chosen for the second trial in the great Phœbe Hearst world competition for the University of California; Professor Homer has had charge of the construction of the new buildings of the Institute.

Courses V. and X., Chemistry and Chemical Engineering. — The removal of the third-year students in analytical chemistry to their new laboratory on the third floor has made available some additional space much needed for the growth and development of the fourth-year work.

The organic laboratory has been considerably enlarged during the preceding summer, so that it now accommodates thirty-six students instead of thirty as heretofore. It has, moreover, been much improved by a large increase in the number of hoods, by a more convenient arrangement of desks, and by the construction of a new skylight, so that the laboratory is now thoroughly lighted.

A laboratory has been equipped for the new course in proximate technical analysis referred to in the report of last year. This course, it will be remembered, comprises the examination of such industrial products as asphalt, rubber, soap, paper, and tannins, and is taken as an option by the larger number of the chemical students in their fourth year.

The facilities for thesis work have been increased by the construction of a photographic dark-room and of a tool-room equipped with a power lathe.

Several of the theses made by the chemical students during the past year have yielded results worthy of publication, fifteen or more articles on theoretical, analytical, and organic chemistry having been published by instructors and students.

No important changes have been made in the courses of instruction in organic chemistry. The fourth-year work has, however, been extended by the introduction of a lecture course on the history of chemistry, given by Dr. Norris,

and by that of a laboratory course in electrical and heat measurements in charge of the Department of Physics.

ANALYTICAL CHEMISTRY. — The total number of students taking analytical chemistry is 135; 92 taking qualitative and 43 quantitative analysis.

This total is larger than it has been ever before, but, with the exception of four students who work but three hours per week, and for whom special provision has been made, each student has a full desk at his disposal. The advantages in increased facility, both of teaching and working, are plainly apparent.

The analytical laboratory on the fourth floor of the Walker Building accommodates, since the alterations of the summer, ninety students, and the new laboratory on the third floor, which occupies the rooms formerly used for the textile coloring laboratory and a private laboratory, has working places for sixty students. The upper laboratory is now used wholly for students taking qualitative and preliminary quantitative analysis, while those taking more advanced quantitative analysis have desks on the third floor. The new laboratory is equipped with steam tables, steam baths, drying closets, and funnel closets of ample capacity, and gives promise of excellent service.

A new private laboratory for the use of the instructors greatly facilitates their work with the students. The former lecture room, which also connects directly with the new laboratory, has been converted into a private laboratory and office for Professor Talbot, and in convenience of access and general accommodation is proving highly satisfactory.

The absorption of the former balance-room on the fourth floor by the Organic laboratory made it necessary to transfer the balances to the former volumetric room, and to do away with the reservation of a special room for this work. The volumetric room was not sufficiently large to accommodate the entire number of students at work in that line, and so much of the volumetric work was necessarily done in the

large laboratory that the transfer of all will not cause a serious drawback. A new balance room is provided on the third floor, and the two rooms will furnish places for thirty balances.

The number of students in the upper laboratory is unusually large this year owing to the exceptional number in Course III., third year, and to the fact that a considerable number of students of the second year of the same course have satisfied the language requirements, and are anticipating the chemical work of the third year. Many of these students will enter the new laboratory next year, and will perhaps tax its capacity; but it does not now appear that the numbers will be as large in the following years.

In general, it may be said that the division of the work in analytical chemistry which is now made possible by the use of the second laboratory seems to be productive of increased ease in teaching, and to be generally beneficial. The changes are of such a nature that if further expansion becomes in time necessary, it can be accomplished with a minimum of change.

The transfer of the supply room to the room formerly known as the Margaret Cheney room is regarded as an improvement in itself, and the room formerly occupied as a supply-room is available as a research laboratory.

The portion of Room 3 formerly the industrial laboratory, which has been reserved to furnish a passageway to the vault, supplies the space needed for the unpacking of goods, and may also be used for special lines of chemical work.

The chemical library has received about the usual number of additions, and is believed to be supplied with all valuable works published during the year.

The outlay for apparatus to equip the new laboratories must necessarily involve a larger net expenditure for this year than is usual in the Department of Chemistry. This is, of course, a temporary demand.

SANITARY CHEMISTRY. — No new work has been undertaken. The pressing demands for space and time in other di-

visions of chemistry seemed to render advisable a temporary pause in the development of a subject which, both in its theory and in its applications, is of growing importance.

The students have had, as before, the benefit of many of the practical problems which are constantly brought to this laboratory from all parts of the country.

Mrs. Richards has had leave of absence for a few weeks in order that she might accept a position on the Faculty of the College for Women, Western Reserve University, Cleveland, where she is to give a course of lectures on the Economics of the Household interpreted in the light of Sanitary Science.

Several other colleges have availed themselves of Mrs. Richards' presence in the West to secure one or more lectures on Sanitary Science and the Chemistry of Food Materials.

Oil and Gas Analysis. — The facilities of the laboratory of Oil and Gas Analysis have been increased by the conversion of the small lecture-room into a private laboratory. A Hinman portable photometer has been added to the equipment of the laboratory.

The department still continues to give instruction to the mechanical and electrical engineers and naval architects in the subject of Gas Analysis. This includes not only the examination of chimney gases, but also the discussion of fuels, smoke prevention, and smokeless furnaces.

Sugar Analysis. — During the past year, owing to a change in the schedule, both junior and senior classes were given instruction in the regular fifteen-hour course in sugar analysis, making about forty students of Course V. Some extra instruction was given to the juniors who were lacking in experience in physical measurements and manipulation of instruments of precision, and their progress proved satisfactory. Four or five students were also given instruction out of course by permission of the Faculty. — Three students took thesis work in this laboratory: G. F. Ulmer ("An Analytical Investigation of the Torrefaction Dextrines"); W. H. Barlow ("The Hydrolysis of Cellulose"); A. L. Goodrich ("Com-

parison of Actual 'Total Solids' of Cane and Beet Juices with those obtained by the Brix Spindle").

The change of location of the laboratory is on the whole a decided improvement, as the present room has been specially fitted for the work.

INDUSTRIAL CHEMISTRY. — During the past summer the laboratory of industrial chemistry has been transferred to new and more commodious quarters in the Pierce Building. The laboratories comprise three work-rooms, large and small store-rooms, and private laboratories for the instructors.

The main laboratory is a room about 56 ft. × 37 ft. 6 in. It is lighted by seven windows in each end and by two large skylights, and is furnished with fourteen 50-candle-power incandescent electric lamps, thus insuring an abundance of light at all times. The ventilation of this new laboratory is far superior to that of the old one, the ventilating system being augmented, in this room, by three large ventilating cowls in the skylights. The number of steam evaporators has been increased from twelve to twenty. They are arranged in a corner of the room and under the skylight having the largest ventilating cowl, which carries off the steam from the evaporators.

The work-benches contain drawers and cupboards for forty-eight students, and that number can be accommodated by having two sections, there being ample bench room for twenty-five students at a time. In addition, there is a large bench set apart for the qualitative and quantitative examination of materials used and of product obtained. The benches are fitted with gas and suction pipes, and a portion of them also with water and waste pipes for distillations. The large gas burners are connected directly with the gas supply, thus avoiding the use of rubber tubing and consequent danger therefrom. The suction pipes — fitted with a tap for each student — are connected with Richards filter pumps and also with a new power-driven combined vacuum and pressure pump, which will also furnish compressed air for various purposes.

This laboratory has five new hoods with glass fronts and sides and soapstone tables. A notable feature is the ample water supply and sink space, there being five sinks placed in a row in the middle of the room, fitted with eight water taps, and having thirty-five feet of working room round them. A new Fletcher's largest size combined crucible and muffle-gas furnace has been added to the equipment for metallurgical work. The efficiency of the hydro-extractors has been increased by the addition of nickel-plated baskets of different sizes, so that small or large quantities of materials can be operated upon with equal facility. The extractors are arranged to be driven direct from an electric motor. A line of shafting driven by the electric motor serves to distribute power to the various machines.

The small industrial laboratory contains the filter press and large knuckle-joint press, and also specimens of work of the students, contained in cases. One-half of this room has been reserved for the students' use as a reading-room. It is furnished with a library table and twelve chairs, a large blackboard, and a small library of works of particular interest to students in industrial chemistry and textile coloring.

The textile coloring laboratory is a room about 40 ft. × 27 ft. 6 in., specially designed for its purpose. Its roof consists of four large skylights facing the north. These and the walls of the room are painted white, which insures the best light for the matching of colored fibres and fabrics. The room is furnished with new benches and work-tables fitted with new and improved dyeing apparatus. They are so arranged that each student has ample room for dyeing on the table at his right hand, and a bench with drawer and cupboard, a balance and all necessary apparatus at his left. A small steam-heated apparatus for aging aniline black colors has been fitted up in this room. A new steam-heated distilling apparatus has been added. It is automatically controlled, requires no attention, and supplies an abundance of distilled water for all needs in the textile and industrial chemistry laboratories.

The class in industrial chemistry this year is slightly smaller than in the two previous years, there being forty-three students enrolled. A slight change in arrangement of the lectures has been made, by which the first six or eight lectures are devoted to the general operations, such as crushing and grinding materials, solution, filtration, evaporation, crystallization, etc., which are commonly employed in all industrial processes. Following these the more important manufactures are taken up in detail, these lectures forming the major part of the course. In addition to written exercises, oral "quiz" exercises are now held in connection with the course, and useful in making clear many obscure points. The completion of Dr. Thorp's text-book will relieve the students from a part of the note-taking during the lectures and furnish them with a digest of the matter covering nearly all important points. The usual number of lectures continues to be given by gentlemen not connected with the instructing staff of the Institute. The customary excursions to factories will be arranged, and in this connection thanks are due to the following-named gentlemen for courtesies extended to the classes: Mr. A. P. Howard, Superintendent Merrimack Chemical Company; Mr. J. deCordova, President Union Glass Company, Somerville; Mr. G. E. Jordan, Agent, and Mr. Getchell, Superintendent, Waltham Bleachery and Dye Works, Waltham; Mr. Thomas H. Hotze, Superintendent Malden and Melrose Gas Light Company, Malden; Mr. E. D. Mellen, Treasurer Curtis, Davis & Co., Cambridgeport; Messrs. Hollingsworth & Whitney, proprietors of the Mattapan Paper Mills, and Mr. Mosman, Superintendent of the mill; Mr. D. J. Flanders, General Passenger Agent, Boston & Maine R.R., for special rates and transportation provided on several of the excursions.

Books Published.

H. P. Talbot: An Introductory Course of Quantitative Chemical Analysis (Third, revised and enlarged edition).

F. H. Thorp: Outlines of Industrial Chemistry.

F. H. Thorp: Inorganic Chemical Preparations.

G. W. Rolfe: Introduction to Sugar Analysis.

ARTICLES PUBLISHED.

Henry Fay and H. P. Talbot: On the Segregation of Carbon in a Piece of Boiler Plate.

J. F. Norris and Henry Fay: Iodometric Estimation of Tellurium.

J. F. Norris and A. I. Franklin: Composition of Nitrogen Iodide.

J. F. Norris: Some Double Salts containing Selenium.

A. G. Woodman: The Differentiation of Organic Matter in Water.

E. H. Richards and I. F. Hyams: *Oscillaria Profilica* in its Relation to Water Supply.

A. H. Gill and A. C. Lamb: The Constants of American Linseed Oil.

A. H. Gill and I. Hatch: On the Bromination Test for Oils.

G. W. Rolfe and Geo. Defren: The Manufacture and Use of Brewing Sugar in America.

A. A. Noyes: 1. Reliability of the Dissociation Values determined by Electrical Conductivity.

2. Die Theorie der Löslichkeitsbeeinflussung bei zweiionigen Elektrolyten mit lauter verschieden en Ionen.

A. A. Noyes and E. H. Woodworth: Investigation of the Theory of the Solubility Effect in the Case of Triionic Salts.

A. A. Noyes and D. Schwartz: The Solubility of the Salts of Weak Acids in Stronger Acids.

A. A. Noyes and E. S. Chapin: The Solubility of Acids in Solutions of the Salts of Other Acids.

A. A. Noyes and L. J. Seidensticker: The Solubility of Iodine in Diluted Potassium Iodide Solutions.

A. A. Noyes and G. T. Cottle: The Velocity of the Reaction between Silver Acetate and Sodium Formate.

Dr. Thorp's Outlines of Industrial Chemistry deserves a

special mention. It is designed for the use of students, and is also furnished with references to original work which will make a guide to the entire literature of the subject. It gives a concise and clear account of manufacturing processes, with an explanation of the chemical principles involved, and supplies a want long felt by teachers.

Courses VI. and VIII., Electrical Engineering and Physics. — The school year 1897–8 has been one of healthy growth in this department. The time gained in the fourth year in consequence of the advanced mathematical requirements for admission to the Institute has allowed the introduction into the Course VI. of a very large amount of additional instruction in the laboratory with great benefit to the students; furthermore, the instruction in dynamo design has been greatly extended. These exercises, however, seriously tax the resources of the department both as to room and instructing force. The same should be said of other additions to the instruction given in the department.

While the actual number of students taking Course VI. has suffered a diminution, coincidently with the increase of certain other courses, the actual work of the Department of Physics, which as a whole is determined more by the variety and specialization of the instruction given than by the actual number taught, shows every year a material increase. I cannot better illustrate this than by the following extract from a statement written a few months since to the Chairman of the Visiting Committee for the department:

"To the fourth-year students in electrical engineering we are this year giving, for the first time, five hours a week instruction in the electrical engineering laboratory, throughout the whole second term. This means that there are five sections in that laboratory, one section every day except Saturday, and practically from eleven to five each day. This is new work, replacing in part the mathematics, which in consequence of the advanced entrance requirements is now taken earlier in the course. In other branches there is also a marked increase of the work done in Courses VI. and VIII.

"But this is by no means all. From the beginning of the Institute the subject of physics has been recognized as of fundamental importance to all students in whatever department they might be studying, and with the development of the school the call for more instruction in special branches of physics, for the benefit of students outside the courses in physics and electrical engineering, has greatly increased. Within the past two years the Physical Department has been called upon to give lectures in applied electricity to all regular students in civil, mechanical, chemical and sanitary engineering, and chemistry, and to many of the mining engineering students as well. We have been asked to give, and hope next year to give, laboratory instruction in dynamo testing to all the mechanical engineering students of the third year. We have introduced an extended laboratory course in heat measurements for all the students in mining engineering, which course is also optional for students in chemistry. Also a course in the laboratory of physical chemistry is required by the course scheme of all chemists of the fourth year. Furthermore, the proposed new scheme of the course in architecture contemplates courses of lectures upon sound as related to architecture, and color, and also one upon the electric lighting of buildings.

"The bare enumeration of these important advances, all of them practically introduced or made effective within the past two years, will show the manner in which the advanced work in physics permeates almost every professional course in the Institute. It also shows that the increasing numbers of students in mechanical engineering, chemistry, and mining engineering and other courses have an immediate effect in increasing the demands upon the Department of Physics."

Apart from the introduction of new courses of instruction, those already existing, without exception, have been materially strengthened, so that the teaching of the department has never been more thorough than at present.

A number of valuable scientific papers have been pub-

lished from the department. There is, moreover, much material embodied in the theses from year to year which is well worthy of publication, if the time of the instructors were not so severely taxed as to render it difficult to put this into suitable shape.

A new edition of the circular relating to the courses in electrical engineering and physics was issued during the summer. Five years had elapsed since the issue of the previous one, and a comparison of the two will show the marked advance that has taken place in that interval.

The following gentlemen engaged in professional work have kindly given lectures during the school year 1897-8, many of them entirely without compensation:

Mr. George W. Blodgett, Electrician of the Boston & Albany Railroad, on the Application of Electricity to Railway Signalling; Mr. Hammond V. Hayes, Electrical Engineer of the American Bell Telephone Company, on Telephone Engineering; Mr. C. J. H. Woodbury, of the American Bell Telephone Company, on Electricity in its Relation to Fire Risks; Mr. Louis Bell, on the Electrical Transmission of Power and the Application of Electricity to Railway Transportation; Mr. S. Everett Doane, of the Marlboro' Electric Company, on the Manufacture of Incandescent Lamps; Mr. Hollis French, on Electrical Engineering Practice and Specifications; Mr. Howard C. Forbes, on the Design and Testing of Electric Light and Power Plants; Mr. John B. Blood on the Design of Alternating Current Machinery; and Mr. Odin B. Roberts, on the Nature and Function of Patents for Inventions.

Many additions have been made to the stock of apparatus of measurement and demonstration since the issue of the last President's Report, especially in heat and electrical measuring instruments. The photometric apparatus has also been brought up to date; and among other instruments a Koenig spectrum photometer has been added thereto. This was purchased from the income of the Katharine Bigelow Lowell

Fund. From the same fund has also been provided a high-grade modern automatic air-pump, the need of which for lecture purposes has long been felt. An unusual amount of apparatus has been constructed in the workshop of the department by the mechanician. Our facilities for such work have been increased by the addition of an engine-lathe larger than any hitherto in our possession.

A number of important changes have been made in laboratory rooms. The laboratory of heat measurements has been enlarged by the addition of a portion of the space vacated by the removal of the laboratory of industrial chemistry. This addition doubles the size of the former room and more than correspondingly increases its availability. While not allowing room for much growth or development, it is sufficient for the present needs of the work and will probably suffice for several years. The necessity for increased space in this laboratory has arisen, not from the demands of students in electrical engineering, who do not receive instruction therein, nor of those in physics, whose needs were previously satisfied, but from the constantly increasing instruction which this department offers to other courses, — in this instance, to those of chemistry, chemical engineering, and mining engineering. This is as it should be, for one of the noteworthy characteristics of the Institute, and one which has contributed very largely to its success, is the manner in which the work of the various departments is coördinated so that each does its appropriate part in the training of every student, forming a marked contrast to the policy of departmental isolation so often followed.

The laboratory of chemical physics has received a large increase in area through the absorption by it of an adjoining room hitherto devoted to certain work in electricity. This increase was imperative unless this laboratory was to curtail its work with the students of Course V. The room is now sufficient for the present work of instruction, but the growing demand for training in this new and important branch is

liable to cause crowding again before many years. The necessities of this laboratory have led to the removal of the photographic dark-room to another place. This has been reduced in size and placed in a corner of the acoustic laboratory.

The loss of room which has thus been sustained by the laboratory of electrical engineering, though unavoidable, is much to be regretted. An endeavor has been made to gain such room as is possible by a rearrangement of apparatus. The small room on the second floor formerly reserved for special measurements of electrical resistance has been converted into a photometer room for use with electric lights. The electric signalling apparatus, a portion of which was erected in this laboratory, is to find a location in one of the buildings on Trinity place, where it is expected to erect the whole of this large and valuable illustrative collection. A small increase has been made to the dynamo-room by the addition of a strip formerly belonging to the laboratory of industrial chemistry.

As to the serious manner in which the work of the department is hampered by lack of room, I can add nothing to what has been said in the Presidents' Reports of the past two years. In the laboratory of heat measurements the need has been met by a substantial addition, and in that of physical chemistry by taking a portion of the laboratory of electrical engineering, as already explained. But this has still further diminished the space devoted to electrical engineering and physics, for which no satisfactory provision has yet been found.

Professor Holman, who has for several years been debarred from school work by severe illness, has published a book upon Matter, Energy, Force, and Work, for the use of those who are dealing professionally as engineers, teachers, or students with these physical concepts. The book is dedicated to the Institute, and it is a remarkable effort of a keen and judicious mind remaining in touch with the work which

was loved so long and done so well. Mind dominating matter might well have been the sub-title of this valuable treatise, and the Institute accepts the dedication with respectful appreciation.

Excursions of Electrical Engineers. — An important feature in connection with the course of electrical engineering in the fourth year is the number of excursions that are made to the various electrical plants and factories in the immediate vicinity of Boston. Here it is that the student sees, generally for the first time, in actual commercial shape, the embodiment of the principles with which he has become familiar in the class-room and laboratory. He is intensely interested, and spends far more time on related problems than he would if these were presented only in a text-book or lecture. These excursions are frequently undertaken by the Electric Club, generally after consultation with some one of the instructing staff, and may be attended by the third and fourth year students.

The longest excursion in the past year, and one that was most highly appreciated by the class, was made under the charge of Professor Puffer, to the great factories of the General Electric Company, at Schenectady, N.Y., in the vacation following the semi-annual examinations.

An excursion like this has the value of a long experimental lecture, illustrated in a large way by machines in all stages of completion. It makes the students acquainted with the best electrical engineering method of dealing with the problems of the day, and of anticipating the wants of the near future.

Course VII., Biology. — For several years the quarters available for the Department of Biology have been totally inadequate. Class work and research have been carried on in one large room, subdivided by partial screens and partitions.

In the Pierce Building the department has now five laboratories, entirely separated one from another; namely, a second-year, or general, laboratory for all the larger classes, but especially for those in general (elementary) biology, micros-

copy, general zoölogy, and elementary botany. This room is used also by the classes in theoretical biology, and in the history of inductive science, as well as by the Journal Club of the department, and for occasional meetings or special lectures. There is, in the next place, a third-year laboratory of smaller size, used almost constantly by the classes in comparative anatomy and embryology, and in cryptogamic botany. Here, also, the fourth-year class in microscopic anatomy does its practical work. Two laboratories are devoted exclusively to the work of the fourth year, one to physiology, and one to bacteriology and its applications to industrial biology and sanitary science. A fifth, the research laboratory, is set apart for the use of investigators, who may be members of the instructing staff, graduate or special students, or regular students engaged in special investigation, such, for example, as thesis work.

In addition to the biological laboratories proper the suite of rooms provided for this department includes four private rooms for the offices, libraries, and personal effects of members of the instructing staff; dark-rooms for optical and photographic work; store and preparation rooms; and a library and reading-room in which are placed the biological books and periodicals belonging to the Institute. The floor area occupied by this new suite of laboratories, etc., is only about two and one-half times that vacated in the Rogers Building, but owing to the shape of the Pierce Building and the careful planning of the whole the convenience and efficiency of the new arrangement are far greater than these figures would indicate.

It is probably entirely fair to say that nowhere in the United States is there so compact or well-arranged a series of laboratories devoted chiefly to the sanitary, hygienic, and industrial aspects of biology. They should be a powerful aid to the Institute as a whole, not only in their own peculiar province, which is daily revealing fresh and important applications to modern life, but also as an ally in the train-

ing of the chemist, the civil and the sanitary engineer, the architect, the geologist, and the student of general science.

The work of the year in this department has been continued on the lines already established in previous years. Professor Sedgwick continues to serve the public in his capacity as an authority on sanitary science and the public health, two large cities in particular, Pittsburgh, Pa., and Newark, N.J., having recently referred to him for solution important questions relating to the purity of their water supplies. Side by side with this work in public hygiene, Professor Hough has begun the extended investigation of an important problem in personal hygiene, viz., the physiology of muscular exercise. Dr. A. W. Weysse, Instructor in Comparative Anatomy, has lately published, with Messrs. Longmans & Co., a useful volume entitled "An Epitome of Human Histology." Mr. S. C. Prescott, Instructor in Bacteriology and Industrial Biology, in coöperation with Mr. W. Lyman Underwood, has carried to a successful issue further researches on the theory and practice of food-preserving, with the result that the Biological Department of the Institute is now regarded by those conversant with the canning industries as the centre of scientific information in the United States for these industries.

This department, which was already under great obligations to Mr. Augustus Hemenway for the gift of a number of high-power microscopes, has recently received from his hand a generous contribution fo the purpose of maintaining for the current year a much-d sired graduate scholarship in biology. Mr. C.-E. A. Wir w, a graduate of the Institute in Biology in the class of 1898, has been appointed to hold this scholarship, and has entered on its privileges, having for this purpose resigned his position as Assistant Inspector of the Board of Health of Montclair, N.J.

Course IX., General Studies. — In the report of last year mention was made of the introduction of a new course to be given to fourth-year students in electrical engineering on

economics of corporations. This has been successfully undertaken. A list of the topics treated is as follows: the historical and legal development of corporations, forms of securities issued, analysis of corporation accounts, regulations in Massachusetts upon issue of securities, the position of quasi-public corporations concerned with the industrial application of electricity, taxes, status and organization of municipal corporations, street railway franchises, and control of electric lighting.

In accordance with a request from the Department in Biology, a brief course will be given this year by Professor Dewey to students of Course VII., on vital and sanitary statistics. This is designed to furnish elementary information in regard to the proper terpretation of registration and health reports which ar essary in problems of public hygiene.

The course heretofore known as "history and literature of the Renaissance and Reformation" has been rearranged and somewhat modified, and the lectures last year given to the students in architecture as a separate course on "the history of sculpture and painting" have been combined with it, the whole being now entitled "history of European civilization and art, principally in the classical, gothic, and renaissance ages." The class now meets in one of the lecture-rooms of the Department of Architecture. A considerable number of books has recently been purchased by that department with a view to the special needs of this course, and an alcove in the new departmental library has been fitted up with cabinets and show-cases for photographs. The collection of lantern-slides and other illustrative material has also been considerably increased — notably by a fine series of photographs of Greek sculpture.

The English Department has during the year endeavored to develop the scheme for the supervision of the written work of students past their first year. Many students have been given special work in writing, and have been guided by

personal advice in consultation. The results have been good, and seem to justify the belief that in this direction lies the secret of the most efficient training of those pupils who are by nature less gifted than others in the power of expression.

An encouraging sign of the increased interest in English is the fact that the advanced composition given for the third year of Course IX. is this term taken as an elective by more than twenty students from other courses. As several of these students are from Course IV., there is reason to believe that the work of the English Department in connection with the architectural memoirs has called attention to the desirability of more facility in composition on the part of those graduating in this course. It is the desire of the department that the system of having papers which are written in regular technical work specially corrected for their English should be extended to all courses.

Course XII., Geology. — The regular work of the classes as represented in the catalogue has been carried out during the year.

The leading event of the year has been the removal of the entire department from the Rogers Building to the new Pierce Building, Trinity place. That opportunity might be given for extensive alterations of the Rogers Building it became necessary to store the whole equipment of the department during the vacation weeks. More recently much time has been occupied in finishing and equipping the new rooms and in arranging the materials for the regular work of instruction. Although there has been much confusion and considerable delay, the classes have not been omitted nor neglected, but the instruction has not been as complete as it would have been if full use could have been had of the department collections.

The arrangement of the new rooms is found to be a decided improvement upon the former one. The articles that are needed for the different classes can now be used either in the room in which they are kept or in an adjacent one with

almost equal ease. Perhaps the most significant advantage of the new quarters is to be found in the mineralogy room. It is now fitted with tables with slate tops, and with drawers in which each student may safely keep his own instruments and notes distinct from others. A large case with many drawers provides for keeping in easy access the specimens to be used in teaching mineralogy. The ventilation and general arrangement of the room are such that the quality of the air in the room during two-hour exercises at blowpipe analysis is very much better than it has been before. The machine for slicing, grinding, and preparing thin sections for study and for giving students practice in this important kind of work is now placed in the same room, and its new location will be a great convenience.

Another important feature is that a special room has now been assigned for economic geology. Where the department was formerly located there was no opportunity for making satisfactory collections for teaching this important branch of the science. As it is now arranged the classes in ore deposits, building stones, and other advanced studies will be accommodated and receive instruction in the same room in which the collections are kept.

The geological library and laboratory are now much better accommodated than previously. In the former room it was impossible to arrange the books as in other department libraries; consequently it was with much difficulty that they were consulted. The size of the valuable palæontological collection was beyond the capacity for keeping it, and some of it remained in boxes and trays which encumbered the rooms. The new room is provided with a larger number of drawers so conveniently arranged that the work can be carried on with comparative ease and facility. A similar improvement has been made in the room for structural geology. The case-room has been largely increased, the room is well equipped, and the facilities for instruction are now satisfactory. The lecture-room is pleasant and very conveniently located.

On account of the value of space the method of keeping the collections in drawers has been generally adopted, only a few specimens being displayed. With the museum of the Boston Society of Natural History so accessible we may well use our own collections solely for the purpose of teaching. The department is now supplied with more than twelve hundred drawers for the convenient keeping and systematic arrangement of its specimens, maps, charts, and appliances for giving instruction.

Course XIII., Naval Architecture. — The work in the department of Naval Architecture is much facilitated by the commodious quarters now occupied. The drawing-room work is better in quality and larger in amount than in former years, because the students are less subject to interruptions and can make drawings to convenient and customary scales. This, together with the advance made in methods of drawing-room instruction, makes it possible to devote practically the whole of the drawing of the fourth year to design, and enables the students to make a design for a ship which shall be as complete as it is desirable to undertake in a technical school.

The valuable collection of drawings and models in the possession of the department is now assembled and arranged for convenient use, and steps have been taken to increase largely the number of both drawings and models.

Mr. James Swan, formerly Instructor in Naval Architecture, has resigned in order to take charge of the scientific department of the drawing office of the Newport News Shipbuilding Company. His work has been intrusted to Mr. Carl H. Clark, a graduate of the class of 1895 from the department of Naval Architecture, who has since been engaged as assistant and instructor, part of the time in marine engineering, and part of the time in naval architecture. He has also had some experience in designing both ships and engines.

Professor Peabody took an active and leading part in the consultations which were held this summer with reference to the programme of studies for United States naval constructors,

and laid out a course of advanced studies directed toward the special problems involved in the construction of warships. This programme formed the basis of the one which was eventually presented by the Faculty to the Naval Department.

Summer Courses.

These courses were given by our instructors with the attendance indicated. They may now be regarded as a well-established auxiliary to our regular work.

Programmes of Summer Courses.

I. Mechanical Drawing and Descriptive Geometry. 27 (Prof. Faunce.)
II. Mathematics: Analytic Geometry. 8. (Mr. George.)
III. Architecture. (*a*) Shades and Shadows. 4. (*b*) Elementary Design. 9. (Mr. Gardner.)
IV. Chemistry. (*a*) Analytical Chemistry. 23. (Dr. Walker.) (*b*) Water Analysis, and Air Analysis. 2. (Mrs. Richards.)
V. Physics. (*a*) Mechanics, Light, and Electricity. 7. (Mr. Drisko.) (*b*) Heat. 11. (Prof. Clifford.) (*c*) Physical Laboratory. 10. (Prof. Goodwin.) (*d*) Electrical Testing. 5. (Prof. Laws.)
VI. European History. 3. (Mr. Wentworth.)
VII. Modern Languages. (*a*) French. 5. (Mr. Bernard.) (*b*) German. 11. (Dr. Dippold.)
VIII. Mechanism. 8. (Prof. Merrill.)
IX. Shopwork. (*a*) Carpentry and Wood Turning. 4. (Mr. Merrick.) (*b*) Forging. 9. (Mr. Lambirth.) (*c*) Chipping and Filing. 8. (*d*) Machine Toolwork. 24. (*e*) Metal Turning. 2. (Mr. Smith.) (*f*) Pattern Making. 3. (Mr. Merrick.)

The "Technology Review."

During the last year the project of a publication intended to reach all the alumni has been carefully considered, and the "Technology Review" (quarterly) is to appear on the first day of January.

The "Review" is planned to be true to its name, and to look over all the widespread fields of interest into which our Institute has entered, to give news of the School to

the graduated classes and of the classes to each other, and to have an educational and literary side attractive to the general reader.

Class life during our busy school years is less active than in most colleges, but the close affiliations or kindred pursuits of the professional work of after years draw graduate class associations together by the closest bonds. They have reason to review their mode of life and training at the Institute during every year that they practise the professions for which we endeavored to educate them; and it is hoped that this new quarterly will be welcomed as a medium for communication about such matters.

STATISTICS.

The Corps of Instructors.

The catalogue of 1898–99 shows the number of instructors of all grades to be 134, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 164. Allusion has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and eight-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1897–98	1898–99
Professors	23	23
Associate Professors	8	7
Assistant Professors	23	23
Instructors	53	53
Assistants	25	28
Lecturers	26	30
Total	158	164

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,171. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1882–83	368
1866–67	137	1883–84	443
1867–68	167	1884–85	579
1868–69	172	1885–86	609
1869–70	206	1886–87	637
1870–71	224	1887–88	720
1871–72	261	1888–89	827
1872–73	348	1889–90	909
1873–74	276	1890–91	937
1874–75	248	1891–92	1,011
1875–76	255	1892–93	1,060
1876–77	215	1893–94	1,157
1877–78	194	1894–95	1,183
1878–79	188	1895–96	1,187
1879–80	203	1896–97	1,198
1880–81	253	1897–98	1,198
1881–82	302	1898–99	1,171

Students by Classes.

The aggregate number of students for 1898–99 is divided among the several classes as follows:

Fellows	4
Graduate students, candidates for advanced degrees	3
Regular students, Fourth Year	181
" " Third "	189
" " Second "	204
" " First "	282
Special students	308
Total	1,171

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows	4	...	4
Graduates of the M.I.T.	3	...	3
Fourth Year	181	60	241
Third Year	189	106	295
Second Year	204	103	307
First Year	282	39	321
Total	863	308	1,171

The Courses of Instruction.

The following table presents the numbers of the regular students in the second, third, and fourth years, by courses:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	32	37	9	22	23	36	1	3	1	10	1	..	9	181*
3d " "	34	34	24	20	16	27	4	2	6	11	3	..	9	189*
2d " "	27	37	19	22	25	31	1	3	5	17	3	1	15	204*
Total . . .	93	108	52	64	64	94	6	8	12	38	7	1	33	574*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1887	50	89	16	18	23	61	5	6	14	..	..	..	..	282
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	3	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st.	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d.	5	..	2	1	..	1	1	..	..	..	..	..	..	..
3d.	5	1	1	..	..	1	1	..	..	1	..	..	..	..
4th.	8	3	2	..	1	1	..	1	..	..	..	..	..	..
5th.	4	..	2	..	1	1	..	..	..	..	..	..	..	..
	26	4	7	1	2	4	2	1	0	1	0	0	0	0

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics	85	Language	171
Architecture	52	Mathematics	156
Biology	31	Mechanical Engineering	79
Chemistry	115	Mining Engineering	19
Civil Engineering	53	Naval Architecture	6
Drawing	133	Physics	179
Electrical Engineering	14	Political Science	77
English	100	Sanitary Engineering	3
Geology	39	Shopwork	71
History	75		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	298	267	126	43	734
Chemistry	353	63	103	71	590
English	302	247	32	1	582
French	102	88	48	..	298
Physics	...	284	301	169	754
German	74	187	173	8	442
Shopwork	12	109	48	57	226

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
California	..	2	3	1	2	8	3	11
Colorado	..	3	..	1	4	6	2	8
Connecticut	..	3	2	9	9	23	3	26
Delaware	..	1	..	1	..	2	1	3
Dist. of Columbia	..	1	..	1	2	4	4	8
Georgia	..	1	1	..	1	3	1	4
Hawaiian Islands	..	..	..	..	1	1	..	1
Illinois	..	7	10	8	13	38	13	51
Indiana	..	..	1	..	..	1	2	3
Iowa	..	4	2	1	..	7	..	7
Kentucky	..	2	1	2	3	8	2	10
Louisiana	..	..	..	1	..	1	..	1
Maine	..	3	6	3	3	15	4	19
Maryland	..	2	1	2	..	5	3	8
Massachusetts	7	106	119	126	187	545	174	719
Michigan	..	2	1	3	2	8	1	9
Minnesota	..	3	..	3	3	9	2	11
Missouri	..	2	1	1	4	8	2	10
Montana	..	..	..	1	..	1	1	2
Nebraska	..	..	1	..	..	1	..	1
New Hampshire	..	5	6	4	4	19	6	25
New Jersey	..	2	3	1	2	8	5	13
New York	..	4	11	11	14	40	28	68
North Carolina	..	..	1	1	..	2	..	2
Ohio	..	3	4	7	3	17	6	23
Oregon	..	..	..	..	1	1	2	3
Pennsylvania	..	8	7	4	3	22	12	34
Rhode Island	..	4	2	3	5	14	9	23
South Carolina	..	..	..	..	..	..	1	1
Tennessee	..	1	..	..	..	1	2	3
Texas	..	..	..	..	..	..	1	1
Utah	..	2	..	1	..	3	..	3
Vermont	..	2	1	2	5	10	2	12
Virginia	..	1	..	1	..	2	1	3
Washington	..	1	2	1	2	6	1	7
Wisconsin	..	1	..	1	3	5	3	8
Foreign Countries.								
Cape Breton	..	..	..	..	..	..	1	1
Cuba	..	1	..	..	..	1	..	1
Denmark	..	..	..	1	..	1	..	1
Dutch Guiana	..	..	1	..	..	1	..	1
England	..	1	1	..	2	4	..	4
France	..	..	..	..	..	..	1	1
Germany	..	..	..	..	1	1	..	1
Japan	..	..	1	..	..	1	..	1
Mexico	..	..	..	..	1	1	6	7
New Brunswick	..	2	..	..	1	3	..	3
Nova Scotia	..	1	..	..	..	1	1	2
Quebec	..	..	..	1	..	1	..	1
Turkey	..	..	..	1	1	2	1	3
Total	7	181	189	204	282	863	308	1171

Thirty-five States of the Union, besides the District of Columbia and the Hawaiian Islands, are represented on our list of students. Of the total number of 1,171, 719 are from Massachusetts, or 61.4 per cent. of the whole; 105 are from other New England States; 346 are from outside New England. Of these, 27 are from foreign countries.

A table showing the number of students in each year, from 1892, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1892	1893	1894	1895	1896	1897	1898
Alabama	4	2	1	..	1	1	1
Arkansas	2	1	..	..	1	1	..
California	14	15	9	8	9	9	11
Colorado	7	5	8	7	7	8	8
Connecticut	27	30	29	27	24	30	26
Delaware	2	4	3	5	5	6	3
Dist. of Columbia	4	7	12	10	17	13	8
Florida	4	3	2	1	..	1	..
Georgia	3	3	2	2	3	4	4
Hawaiian Islands	2	2	..	..	..	..	1
Idaho	1	1	..	1	1	1	..
Illinois	46	39	36	42	45	40	51
Indiana	5	6	3	2	3	7	3
Iowa	10	13	10	12	14	12	7
Kansas	1	1	4	4	3	3	..
Kentucky	7	11	12	11	12	10	10
Louisiana	2	3	3	2	..	1	1
Maine	39	30	38	38	27	24	19
Maryland	6	4	4	9	9	8	8
Massachusetts	603	665	707	721	730	739	719
Michigan	10	7	8	7	6	5	9
Minnesota	13	11	9	5	7	8	11
Missouri	13	17	14	9	11	6	10
Montana	..	2	2	1	3	5	2
Nebraska	4	3	4	2	2	2	1
Nevada	3	2	2	..	..	..	..
New Hampshire	20	32	27	30	26	25	25
New Jersey	11	6	5	5	13	15	13
New Mexico	2	2	1	1	..	..	..
New York	50	52	59	61	69	62	68
North Carolina	1	..	..	..	1	1	2
Ohio	39	45	50	37	28	30	23
Oregon	2	1	1	1	4	3	3
Pennsylvania	25	31	37	36	42	41	34
Rhode Island	24	33	45	21	20	19	23
South Carolina	1	3	3	5	6	4	1
Tennessee	1	1	1	1	1	3	3
Texas	5	6	6	3	2	2	1
Utah	1	2	2	5	2	3	5
Vermont	4	5	3	5	7	11	12
Virginia	4	3	2	5	3	4	3
Washington	3	1	3	1	5	4	7
West Virginia	2	1	1	3	2	1	..
Wisconsin	9	11	6	7	6	6	8
Wyoming	..	..	..	..	1	..	..
Foreign Countries.							
Belgium	1	1	1	..	..	..	..
Brazil	..	..	1	1	..	..	..
Bulgaria	1	1	..	..	..	..	..
Cape Breton	..	..	..	..	..	..	1
Central America	1	1	..	1	..	..	..
Chile	..	..	1	1	1	..	..
Columbia	..	..	..	..	..	..	..
Cuba	..	1	1	3	2	1	1
Denmark	..	..	..	..	..	2	1
Dutch Guiana	..	..	..	..	..	..	1
England	1	1	..	2	2	2	4
France	1	1	..	..	1	1	1
Germany	..	2	1	..	..	..	1
Guatemala	1	..	..	..	..	..	..
Holland	2	2	2	..	..	..	..
Ireland	..	1	1	..	..	..	..
Japan	1	1	1	2	2	..	1
Mexico	1	1	1	1	3	6	7
New Brunswick	1	1	1	1	2	2	3
New South Wales	1	1	1	1	..	..	..
Nova Scotia	..	..	1	2	1	1	2
Ontario	2	4	4	2	2	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	..	1	1	1	..	..	..
Quebec	5	5	2	2	2	2	1
Scotland	1	2	1	..	..	..	..
Spain	1	1	1	1	..	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	1	..	1	3	1	3	3
Venezuela	..	1	1	1	1	..	..
Total	1060	1157	1183	1187	1198	1198	1171

Residence of Massachusetts Students.

It has been said that 61.4 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and twenty-two cities and towns are on the lists. The first column of the following table shows the number of cities and towns in each county

sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and thirty-three and Suffolk two hundred and fourteen pupils; Essex comes third, with ninety-nine; Norfolk, fourth, with sixty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	5	6	Hampshire	3	3
Berkshire	4	10	Middlesex	34	233
Bristol	5	23	Norfolk	18	65
Dukes	1	1	Plymouth	10	23
Essex	21	99	Suffolk	3	214
Franklin	5	5	Worcester	9	22
Hampden	4	15			
			Total	122	720

The following is a list of the towns, thirty-eight in number, which send four or more students to the Institute:

Boston	200	Lawrence	10	Fall River	5
Newton	46	Lynn	10	Lexington	5
Cambridge	35	Springfield	10	Medford	5
Brookline	24	Winchester	10	Quincy	5
Lowell	23	Brockton	9	Weston	5
Newburyport	22	Hyde Park	9	Worcester	5
Somerville	18	Framingham	7	Andover	4
Malden	15	Haverhill	7	Everett	4
Arlington	12	Melrose	7	Holyoke	4
Gloucester	13	Waltham	7	Peabody	4
Chelsea	11	Fitchburg	6	Pittsfield	4
New Bedford	11	Natick	6	Taunton	4
Salem	11	Canton	5		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First year Students.	(5) No. of New Students not of the regular First-year Class.
1889–90	909	557	352	255	97
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	709	402	278	124

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and seven persons of unusual ages. These deductions

Period of Life.	1897–98.		1898–99.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	..	2	..
16½ to 17 "	1	2	5	7
17 to 17½ "	16	..	16	..
17½ to 18 "	33	49	32	48
18 to 18½ "	45	..	45	..
18½ to 19 "	39	84	51	96
19 to 19½ "	58	..	54	..
19½ to 20 "	25	83	28	82
20 to 20½ "	25	..	16	..
20½ to 21 "	9	34	10	26
21 to 22 "	9	9	13	13
	261	261	272	272

leave two hundred and seventy-two as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1897–98.

From the foregoing it appears that the average age on entrance is eighteen years and eleventh months.

In this connection I present the ages, at graduation, of the class leaving us in June. The one hundred and ninety-eight members of the class were distributed among the different periods of life as follows:

Under 20½	2
Between 20½ and 21	13
" 21 " 21½	16
" 21½ " 22	22
" 22 " 23	67
" 23 " 24	38
" 24 and over	40
Total	198

The special students this year constitute twenty-six per cent. of the whole body, as against twenty-eight per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is sixty-eight. Of these eleven are our own graduates, three being candidates for advanced degrees. Fifty-five are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Twelve are graduates of Harvard University; four each of Yale University and Amherst College; three of Williams College; two each of Johns Hopkins, De Pauw, and Princeton Universities, and King's College, Windsor, N.S.; while the following institutions are represented on our list by a single graduate each: Brown, Chicago, Cornell, Georgetown, McGill, Michigan, Minnesota, Vermont, and Wisconsin Universities; Boston, Carleton, Central Turkey, Davidson, Doane, Hobart, Gonzaga, Iowa State Agricultural, Monmouth, New Hamp-

shire, R.I. Agricultural and Mechanic Arts, Robert, St. John's, Simpson, Smith, South Kentucky, and Vassar Colleges; Colegio de Carreras.

Women as Students at the Institute.

The number of women pursuing courses with us is forty-seven. Of these, two are graduates of colleges. Of the total number, three are regular students of the fourth year; four of the third year; five of the second year; five of the first year. Thirty are special students. Of the twelve regular students of the upper classes, three take Course IV., Architecture; four, Course V., Chemistry; one, Course VII., Biology; three, Course VIII., Physics; one, Course IX., General Studies. Of the special students, nine devote themselves to Biology, ten to Chemistry, four to Architecture, two to General Studies, one to Physics, one to Geology, two to Mathematics, and one to Drawing.

The diminution by twenty-two in the total number of women students is to be traced chiefly to the loss of twenty-one from the Biological Department. These are mostly special students, and were probably deterred from entering this year because of the removal of that department to the Pierce Building, which occasioned a delay of a month in preparation of the laboratories to receive students.

Statistics of Examinations.

Of the 1,171 students of the present year, 402 were not connected with the school in 1897–98. Of these, 269 were admitted as regular students of the first year upon the basis of their entrance examinations. The 133 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who

were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 269 who were thus admitted to the Institute on examination, and have taken their place in the school, 55 were admitted on examination, but have not entered the school.

In the case of the 269 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	194
" on one condition	48
" on two conditions	20
" on more than two conditions	7
	269

Forty applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Albany, Belmont (Cal.), Buffalo, Chicago, Cincinnati, Cleveland, Concord (N. H.), Denver, Detroit, Easthampton (Mass.), Glens Falls (N. Y.), Kansas City (Mo.), Kingston (Pa.), Louisville, New York, Philadelphia, Pittsburgh, Portland (Me.), Portland (Oreg.), Pottstown (Pa.), Poughkeepsie, Springfield (Mass.), St. Louis, St. Paul, and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	.	14
1869	2	2	. .	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	..	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	27	3	5	13	..	18	3	2	6	..	..	..	..	102
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	16	..	48	3	3	7	7	4	3	5	188*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	23	..	33	3	4	6	9	3	..	7	197
Totals	375	449	159	154	219	1	352	34	30	73	70	24	8	26	1,971
Deduct names counted twice															11
Net total															1,960

* Deducting names counted twice.

SOCIETY OF ARTS.

BOSTON, June 30, 1898.

To the President of the Institute:

SIR: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year 1897–98.

The first meeting of the year was held on October 28, no meeting being called for the 14th because the Corporation had arranged for a Memorial Meeting to be held on that date in honor of the late President Walker. In all, twelve meetings have been held, and the following papers have been read: "Recent Work in Heat Measurement at the Institute," by Mr. Charles L. Norton; "Cable and Underground Electric Roads," by Mr. Louis J. Hirt; "Contributions to our Knowledge of the Micro-organisms and Sterilizing Processes in the Canning Industries, II., The Souring of Sweet Corn," by Messrs. S. C. Prescott and W. Lyman Underwood; "The Concentration of Ores, with Special Reference to Recent Investigations on the Subject," by Prof. R. H. Richards; "A New System of Pneumatic Dispatch Tubes," by Mr. B. C. Batcheller; "The History and Present Development of the American Bicycle," by Dr. Leonard Waldo; "On Town, State, and City Boundaries," by Mr. Henry B. Wood; "Certain Sanitary Aspects of Jamaica," by Mrs. Ellen H. Richards and Mr. Arthur T. Hopkins; "On Fire-Proof Construction," by Dr. S. Albert Reed; "On the Constitution of Steel Considered as an Alloy of Iron and Carbon," by Mr. Albert Sauveur; and "The Economic Relations of Deep Inland Waterways to the State of New York," by Mr. George W. Rafter.

The membership of the Society of Arts continues to increase, although there have not been added so many new

members as during the previous year. At the close of the year 1896–97 the number of life members was 59; 6 have died since then, leaving the present number 53. The number of associate members a year ago was 311; of these, 1 has died and 9 have resigned. These losses are offset by the election during the year of 22 associate members, making the total number 323.

Early in the autumn the Executive Committee lost one of its members by the death of Mr. Thomas Doane, who was distinguished as an engineer and as the founder of Doane College in Nebraska. He had been connected with the Society as a life member for many years. The other life members who died during the year are John M. Forbes, Joseph S. Fay, John Lowell, Theodore Lyman, and Jacob Norton. We have lost one associate member by death, Mr. C. H. Parker, of Cambridge.

A notable event in the history of the Society of Arts was the election of Professor James M. Crafts to be President of the Institute. He was introduced to the Society as its President at the meeting of October 28th.

An Amendment to the By-Laws of the Society of Arts was adopted by the Society December 9, with the approval of the Corporation. This amendment provides that three members shall constitute a quorum of the Executive Committee for the transaction of business.

The Board of Publication, which has charge of the "Technology Quarterly" and "Proceedings of the Society of Arts," was reappointed, with the exception of Prof. Henry M. Howe, who has removed to New York, Prof. Charles R. Cross being chosen in his place. The following members now constitute the Board of Publication, viz.: Prof. W. T. Sedgwick, Chairman, Prof. Charles R. Cross, Prof. Dwight Porter, A. Lawrence Rotch, Esq., and the Editor, Dr. R. P. Bigelow.

From 1880 to 1891 the Society of Arts published an annual volume of "Proceedings." The "Technology Quarterly" was founded in 1887 by the students, and was published by a

board of editors chosen from the junior and senior classes, William S. Hadaway, Jr., '87, being the first editor-in-chief. Two years later Mr. James P. Munroe became the sole editor, under the auspices of the Faculty, and in 1892 the control of the journal was transferred to the Society of Arts and it was united then with the "Proceedings." Thus it became an official organ of the Institute. By a vote of the Society, the Executive Committee was authorized to appoint annually a Board of Publication to exercise a general control and supervision over the "Quarterly." The active management, however, falls upon the editor, who is appointed by the Executive Committee upon nomination by the Board of Publication.

During the present year the "Technology Quarterly" has published not only the minutes of proceedings of the Society and a number of papers read at its meetings, but it has contained also a number of original articles, which have been presented to the Society by title only. The series of results of tests made in the Engineering Laboratories has been continued, as well as the Review of American Chemical Research.

The last meeting of the year was the 36th annual meeting of the Society of Arts. At this meeting Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Frank W. Hodgdon, and Charles T. Main, were elected members of the Executive Committee, and Mr. Arthur T. Hopkins was elected Secretary for the year 1898–99.

Respectfully submitted,

ROBERT P. BIGELOW,

Secretary.

LOWELL SCHOOL OF DESIGN.

The Lowell School of Design has a satisfactory report to make of the year's work. The number of students is limited to forty-two, and it is intended to open the class only for those who are thoroughly prepared to take the work. The students are diligent and take an intelligent interest in their pursuits, and coöperate with the director in maintaining a high standard of work. The accounts received from mill superintendents and others, employers of those students, who, since the opening in 1872, have received their education at this school, lead us to believe that the demands for a professional education of designers have been well understood and met. The embroidery designs, water colors, and decorated china made by the female students find a ready sale.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1898.

The past year has been a remarkable one in the financial history of the Institute. More money has been received through bequests and gifts than in any previous year. Under the will of the late Hon. Henry L. Pierce seven hundred and fifty thousand dollars have been paid to the Institute by his executors. This is the largest sum ever given to it by any one person. In addition to this the executors of the late Mrs. Julia B. Huntington James have paid over the very notable sum of one hundred and forty thousand five hundred dollars. This is also one of the largest gifts ever made to the Institute.

George A. Gardner, Esq , has generously given twenty thousand dollars as a fund, the income from which is to be used in the payment of salaries, a purpose for which money is much needed. Ten thousand dollars have come from the estate of the late John Foster, and sixty-two hundred and fifty dollars from that of the late John W. Carter, and fourteen hundred and eighty-two dollars and seventy-nine cents have been added to the sum previously received from the estate of the late Mrs. Susan E. Dorr for the Rogers Physical Laboratory.

Besides these gifts to the Institute itself a Travelling Fellowship in the Architectural Department has been established by the will of Willard B. Perkins. For this purpose the sum of six thousand dollars has been given, the accumulated income from which is to be used every fourth year.

Forty thousand dollars have come from the estate of the late Mrs. Ann White Dickinson, the whole sum for scholarship purposes.

A friend has given five hundred dollars to meet a special want, and two hundred dollars have come from Mrs. William B. Rogers, to be used for periodicals.

This great increase in funds came at a time when it was very much needed. It led at once to the erection of the new fireproof building in Trinity place, which is to bear the name of the late Hon. Henry L. Pierce It has also made possible extensive changes and improvements in the old buildings.

In current expenses there has been a saving in fuel, water, gas, electricity, printing, interest, and expenses of the Society of Arts, amounting in all to nearly seven thousand dollars. This saving, however, has been much more than offset by an increase of about nine thousand dollars in salaries, sixteen thousand in repairs, and three thousand in general expenses.

The result is an adverse balance of more than seven thousand dollars in current expense account. It must, however, be borne in mind that all payments made for the extensive alterations and improvements in the old buildings have been charged to repair account. The increase of sixteen thousand dollars in the repair account is due to these changes. Next year we need not expect any such expenditure as this, but we shall have the increased expense involved in the use of the new building.

During the year the debt has been reduced from a hundred and twenty thousand dollars to twenty thousand. About a hundred thousand dollars have been paid on account of the new building, and there have been deducted from the bond premium account more than thirty-four hundred dollars

In addition to the payment of the above note, the property of the Institute, after deducting insurance money which will be required for restoring the buildings damaged by fire, has been increased by eight hundred and sixty-seven thousand two hundred and forty-six dollars and ninety-nine cents.

Securities Sold or Paid, General Account.

$1,000	Bur. & Missouri River R R. 6s., 1918	1,000.00
3,000	Chi., Milwaukee & St. Paul R.R. 7 3/10s., 1898	3,000.00
3,000	Am. Bell Telephone 7s., 1898	3,000.00
16	Rights Boston Real Estate Trust	216.00
		7,216.00

Securities Bought or Received as Legacies, General Account.

$1,000	Bur. & Missouri River R.R. non-exempt 6s.,	1918	1,080 00
3,000	Chi., Milwaukee & St. Paul R.R. 7s.	1905	4,140.00
3,000	Am. Bell Telephone 7s.	1898	3,000.00
46,000	Chi. Junct. & Union Stock Yards 5s.	1915	51,340 00
5,000	Dominion Coal Co. 1st. 6s.	1913	5,150.00
2,000	Low., Law. & Haverhill St. Ry. 5s.	1923	2,020.00
2,000	New England Tel. & Tel. Co. 6s.	1907	2,160.00
2,000	N. Y. & New England R.R. 7s.	1905	2,340 00
21,000	N. Y. & New England R.R. 6s.	1905	23,220.00
100,000	West End Street Ry. 4s.	1917	104,000.00
50,000	Utah & Northern R.R. 1st. 7s.	1908	60,875.00
150,000	Walter Baker Co. Ltd. 4½s.	1903	150,000 00
50	Sh. Boston & Albany R R.		10,750.00
50	" N. Y., New Haven & Hartford R.R.		9,000.00
50	" Boston & Maine R.R., common		8,300.00
25	" Boston & Providence R.R.		6,625.00
55	" Chi., Burlington & Quincy R R.		5,225.00
50	" Chi., Mil. & St. Paul R R., Pf.		7,000.00
50	" Chi., Rock Island & Pacific R.R.		4,350.00
50	" Fitchburg R.R., Pf.		4,800.00
55	" New England Tel. & Tel. Co.		6,755.94
50	" American Bell Telephone Co.		12,750.00
60	" Pullman's Palace Car Co.		10,200.00
23	" Boston Real Estate Trust		26,128.00
			521,208.94

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance Sept. 30, 1897		35,962.67
From Augustus Lowell for Lowell Courses	5,700.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500 00	
		8,700.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	3,504.00	
" " " " scholarships (students' fees)	7,325.00	
" " " " Joy "	150 00	
" " " " Swett "	400 00	
" " " " Savage "	400 00	
" " " " Library	480 00	
" " " " general purposes	12,494.60	
" " Rogers Memorial Fund	10,949.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Fund used 1897	450.00	
Letter Box Fund used 1897 [46.50]	125.00	
Students' fees	216,832.00	
State Scholarships	4,000.00	
U. S. Grant of 1862	5,131.37	
U. S. Grant of 1890	8,000.00	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	8,863.02	
Rents, per Table (page 94)	11,318.99	
Gifts	700.00	
Interest	9,673.03	
Boston University	1,150 00	
Sale printed Lecture Notes	2,593.87	
		331,035.03
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase James Savage Fund	121.25	
" Dalton Graduate Scholarship Fund	212.76	
" Joy Fund	50.00	
" W. B. Rogers Fund [additional]	300.00	
Susan E. Dorr Fund [" 1,482.79]	1,662.79	
Ann White Dickinson Fund ["]	40,000.00	
Rotch Prize Fund	400.00	
Willard B. Perkins Fund	6,080.00	
Geo. A. Gardner Fund	20,000.00	
		68,826.80
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
John Foster Legacy	10,000 00	
Henry L. Pierce Legacy	750,000.00	
John W. Carter Legacy	6,250.00	
James Fund	140,500.00	
		906,750.00
SECURITIES SOLD OR PAID. GENERAL FUND, page 85		7,216.00
SUNDRIES.		
Income credited to Bond Premium Acct.	2,920.51	
Income credited to Rogers Bond Premium Acct.	500.00	
Boston Art Students' Association on acc't	666.67	
Students' Notes paid	440.00	
Insurance, Engineering Building	27,979.20	
		32,506.38
		$1,390,996.88

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPTEMBER 30, 1898.

Cr.

Paid for Lowell Courses	5,700.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		8,700.00
EXPENSES.		
Salaries, per Table (page 94)	231,955.72	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	450 00	
Repairs, per Table (page 95)	27,206.89	
General Expenses, per Table (page 95)	17,245.67	
Fuel	5,360.16	
Water	1,810.40	
Gas	2,060.90	
Electricity	882.42	
Printing and Advertising	2,764.12	
" Lecture Notes	1,306.16	
" Annual Catalogues and Reports	2,313.82	
Rents paid Boston & Albany R. R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 94)	34,784.05	
Society of Arts	593.31	
Interest allowed on funds not in Bonds and Stocks, at 4 per cent.	2,476.17	
Interest paid A. Lowell, Trustee	1,000.00	
" " on Mortgage Notes	2,000.00	
Mech. Eng. & Applied Mechanics Department Improvements	500.00	
Memorial of Francis A. Walker	1,453.67	
Omaha Exposition	326.62	
		338,170.08
[Expenses more than Income, $7,135.05]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES. GENERAL ACCOUNT, page 85		521,208.94
Pierce Building, Trinity Place, on acct.		99,638.90
Fire Repairs, Engineering Building		7,383.27
" " " Contents		4,133.30
SUNDRIES.		
Notes Payable	100,000.00	
Notes Receivable	200,000.00	
Students' Deposits	100.00	
Funds of 1897, used	1,094.76	
		301,194.76
Cash balance, Sept. 30, 1898		110,567.63
		$1,390,996,88

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1898:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
16,000.00	Kansas City, Cl. & Springfield R.R. 5s.	1925	16,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000 00	
5,400.00	Republican Valley R.R. 6s.	1919	5,400 00	
4,000 00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000 00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00	
2,000 00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Kansas City, Memphis & Birmingham R.R.			
	1,000 General Mortgage 4s.	1934	2,221.40	
	2,000 Income 5s.	1934		
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
42,000.00	Chi., Bur. & Quincy R.R. Conv. 5s.	1903	40,820.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
	255 Shares Detroit, Grand Rapids & Western Pfd., par 100		12,500.00	
	Advance to Bond Premium account		7,400.00	
	Bonds and Stocks			249,453.90

INVESTMENTS, GENERAL ACCOUNT.

$14,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	14,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
6,000.00	Chicago, Burlington & Quincy R.R. 4s	1922	5,100.00	
3,000.00	Chicago, Mil. & St. Paul R.R. 7s	1905	3,000.00	
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000 00	
3,000 00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
15,000.00	Chi., Bur. & Quincy R.R. Conv. 5s.	1903	15,000.00	
6,000.00	West End Street Ry. 5s	1902	6,000.00	
2,000.00	Brookline Gas Light Co. 5s.	1913	2,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000 00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
46,000.00	Chic. Junc. & Union Stock Yards 5s.	1915	46,000.00	
5,000.00	Dominion Coal Co. 1st. 6s.	1913	5,000.00	
2,000.00	Low., Law. & Haverhill St. Ry. 5s.	1923	2,000.00	
2,000.00	New England Tel. & Tel. Co. 6s.	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st. 7s.	1908	50,000.00	
150,000.00	Walter Baker Co. Lt'd. 4½s	1903	150,000.00	
	Advances to Bond Premium account		26,526.43	
	Bonds			594,626.43
	Amount carried up			$844,080.33

Amount brought up $44,080.33

STOCKS.

SHARES.				
198	Boston & Albany R.R.	par	100	40,683.00
194	Morris & Essex R.R.	"	50	14,690.00
40	New York & Harlem R.R.	"	50	5,000.00
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00
100	N.Y., New Haven & Hartford R.R.	"	100	17,000.00
50	Boston & Maine R.R. common	"	100	8,300.00
25	Boston & Providence R.R.	"	100	6,625.00
55	Chi., Bur. & Quincy R.R.	"	100	5,325 00
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00
50	Chi., Rock Island & Pacific R.R.	"	100	4,350 00
50	Fitchburg R.R. Pf.	"	100	4,800 00
60	Pullman's Palace Car Co.	"	100	10,200.00
12	Cocheco Manufacturing Co.	"	500	6,000.00
56	Hamilton Woollen Co.	"	100	5,390.00
59	Everett Mills	"	100	5,310.00
31	Great Falls Manufacturing Co.	"	100	3,472.00
6	Manchester Mills	"	100	660.00
2	Dwight Manufacturing Co.	"	500	1,600.00
1	Merrimack Manufacturing Co.	"	1000	1,015.00
1	Laconia Co.	"	400	605.00
2	Pepperell Manufacturing Co.	"	500	2,300 00
10	Lowell Bleachery	"	100	975 00
37	Essex Co.	"	50	3,780.00
158	Pennsylvania Coal Co.	"	50	23,160.50
15	Consolidated Gas Co., New York	"	100	1,447.50
7	Lowell Gas Light Co.	"	100	1,610.00
40	Cambridge Gas Light Co.	"	100	7,000 00
7	Lawrence Gas Light Co.	"	100	882.00
55	Old Boston National Bank	"	100	5,510.50
15	Merchants' National Bank	"	100	2,220 00
25	New England National Bank	"	100	3,875.00
25	Atlantic National Bank	"	100	2,875.00
10	National Union Bank	"	100	1,240.00
25	National Bank of the Republic	"	100	3,625.00
40	The Molsons Bank, Montreal	"	50	3,000.00
37	Nat. Mechanics Bank, Baltimore	"	10	706.70
10	First Nat. Bank of Baltimore	"	100	1,293 30
39	Boston Real Estate Trust	"	1000	44,212.00
1	Boston Ground Rent Trust	"	1000	900.00
50	American Bell Telephone Co.	"	100	12,750.00
55	New England Tel. & Tel. Co.	"	100	6,755.94
				290,923.44

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123 70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,154,127.47

Amount brought up		1,154,127.47

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg., Trinity Place	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Architectural "		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Pierce Building, Trinity Place		99,882.47	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
			1,089,022.03
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80

SUNDRIES.

Notes Receivable	278,500.00	
Boston Art Students' Association	11,666.66	
Students' Notes	1,405.50	
Cash Balance, Sept. 30, 1898	110,567.63	
		403,139.79
		$2,682,473.09

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	50,000.00	
James Fund	140,500.00	
		620,090.11
Amount carried up		$620,090.11

Amount brought up		620,090.11
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,209.82	
James Savage Fund	13,552 45	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,878.29	
Joy Fund	9,173.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253 93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,796.19	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,726.82	
Ann White Dickinson Fund	40,000.00	
Dalton Fund	5,531.81	
Willard B. Perkins Fund	6,080.00	
		251,145.14
OTHER TRUSTS.		
Charlotte Billings Richardson, Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,245.97
Susan E. Dorr Fund		5,420.59
William Hall Kerr, Library Fund		2,000.00
Biological Instrument Fund		143.50
Charles Lewis Flint, Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch "Special" Prize Fund		5,200.00
Letter-box Fund, balance		63.87
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	150.00	
Fire Insurance, Engineering Building	16,462.63	
Moses Kimball Legacy, 1896	5,000.00	
Benjamin P. Cheney Legacy, 1896	10,000 00	
Susan G. Coolidge Devise, 1896	14,500.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	750,000.00	
John W. Carter Legacy, 1898	6,250.00	
M.I.T. Stock Account	779,622.50	
		1,611,985.13
		$2,682,473.09

Comparative Statement of Funds, etc.

	Sept. 30, 1897.	Sept. 30, 1898.
Trusts for general purposes	479,590.11	620,050.11
" " Salaries	87,600 00	107,600.00
" " Scholarships	204,979.23	251,145.14
" " Library	7,000 00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,246.13	1,245.97
Susan E. Dorr Fund	3,757.80	5,420 59
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,225.00	5,200.00
Rotch "Special" Prize Fund	5,225.00	5,200.00
Catherine P. Perkins Legacy	102,781.40	
Henry C. Hutchins "	2,000.00	
Moses Kimball "	5,000.00	5,000.00
Benj. P. Cheney "	10,000.00	10,000.00
John Foster "		10,000.00
Henry L. Pierce "		750,000.00
John W. Carter "		6,250.00
Susan G. Coolidge Devise	14,500.00	14,500 00
Letter-box Fund	110.37	63.87
Biological Instrument Fund	143 50	143.50
Students' Deposits	250.00	150.00
Notes Payable	120,000.00	20,000.00
Fire Insurance, Engineering Building		16,462.63
M.I.T. Stock Account	681,976.15	779,622.50
	$1,798,763.47	$2,682,473.09
Increase		
Consisting of:		
Bequests for Special Purposes, etc. See page 86		68,826.80
Gifts and Bequests for General Purposes. See page 86		906,750.00
Fire Insurance		16,462.63
		992,039.43
Less Notes Payable Paid	100,000.00	
" Funds of 1897 used	1,094.76	
" Students' Deposits	100.00	
" Expenses more than Income	7,135.05	
		108,329.81
		$883,709.62

	Sept. 30, 1895.
	620,050.11
	107,600.00
	251,145.14
	7,000.00
	37,378.78
	1,245.97
	5,420.59
	5,000.00
	25,000.00
	5,200.00
	5,200.00
5,000.00	
10,000.00	
10,000.00	
750,000.00	
6,250.00	
14,500.00	
63.87	
143.50	
150.00	
20,000.00	
16,462.63	
779,622.50	
2,682,473.09	
68,826.80	
996,750.00	
16,462.63	
992,939.43	
108,329.81	
$883,709.62	

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	3,504.00
" " Scholarships	6,726.74
" " " James Savage Fund	400.00
" " Charlotte B. Richardson Fund	1,495.15
" " Rotch Prize Funds	400.00
" " Library	480.00
" " General Purposes	12,494.60
" " Increase of Funds	594.01
" " Advances to Bond Premiums	2,920.51
	$29,015.01

From Dividends, Bank Stocks	1,080.00
" State Tax returned on Bank Stocks	228.94
" Bonds	15,410.38
" Dividends, Railroad Stocks	5,608.00
" " Coal and Gas Stocks	1,980.00
" " Manufacturing Stocks	902.00
" Telephone Stocks	540.00
" Real Estate Stocks	789.52
" Interest allowed on Funds not in Bonds and Stocks @ 4%	2,476.17
	$29,015.01

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,949.00
Credited to Advances Bond Premiums	500.00
	$11,449.00

Received Income from Railroad Bonds	11,449.00
	$11,449.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		75 00	
Land and Building, Clarendon St., on account		4,000.00	
34 Commonwealth Avenue, 1 year	2,200.00		
less Annuity under Will	1,000.00		
less Tax	360.10		
	1,360.10		
		839.90	
Use of Rooms and Gymnasium		1,393.79	
		11,608.69	
less Tax and Repairs, Cambridge		289.70	
			11,318.99

Department Supplies.

Civil Engineering	2,738.52	
Mechanical Engineering	2,903.32	
Applied Mechanics	1,639.91	
Mining	2,380.94	
Architecture	2,652.15	
Chemistry	8,944.39	
Physics	6,127.90	
Biology	1,127.87	
English	928.58	
Modern Languages	90.35	
Geology	515.66	
Naval Architecture	590.66	
Drawing	100.51	
Mathematics	103.89	
Military	104.25	
Periodicals	1,861.23	
Workshops	1,973.92	
		34,784.05

Salaries.

Instruction	186,170.02	
Administration	24,266.88	
Labor	21,518.82	
		231,955.72

CASH

11,318.99

34,784.05

231,955.72

General Expenses.

Fire Insurance		2,941.63
Stationery and Office Supplies		2,164.58
Furniture		2,201.87
Electric Wiring		2,162 05
Postage		1,612.51
Janitor's Supplies: Brushes, Paints, etc.		801.20
Entrance Examinations		723.83
Express Charges, Teaming, etc.		636 96
Sundries		614.37
Diplomas		587.40
Washing		519.44
Engine Room Supplies:		
Oil	242.29	
Cotton Waste	44.18	
Sundries	37.24	
		323.71
Ice		255.36
Glass		206 99
Books, Supplies, etc., for General Library		179.29
Lowell School of Design		161.74
Window Shades		159.35
Paints, Varnish, etc.		152.52
Graduation Exercises		149.85
Type-writing Machine		102.50
Examination Books		100.00
Raffle Plates for Boiler		100.00
Blackboards		99.16
Telephone & Telegraph Co.		94.24
Gymnasium Supplies		93.12
Union Deposit Vaults		75.00
Western Union Telegraph Co.		27.00
		17,245.67

Repairs.

Department Improvements:		
Civil Engineering	126.29	
Mechanical Engineering	1,037.45	
Applied Mechanics	126.20	
Mining	2,447.23	
Architecture	304.13	
Chemistry	4,050.33	
Physics	889.08	
Biology	16.25	
English	7.73	
Geology	123.75	
Naval Architecture	263.67	
Drawing	40.53	
Military	2.30	
Workshops	1,217.71	
		10.652.65
Sundries		6,212.13
Rogers Building		5,825.10
Walker Building		1,662.94
Steam Fitting		741.25
Architectural and Engineering Buildings		612.36
Gymnasium		435.28
Boilers, Tools, etc.		264.80
Huntington Hall		233.90
Ventilation Engineering Laboratory		224.55
Lawn Tennis Court		216.93
Deane Steam Pump		125.00
		27,206.89

BOSTON, December 7, 1898.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1898, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

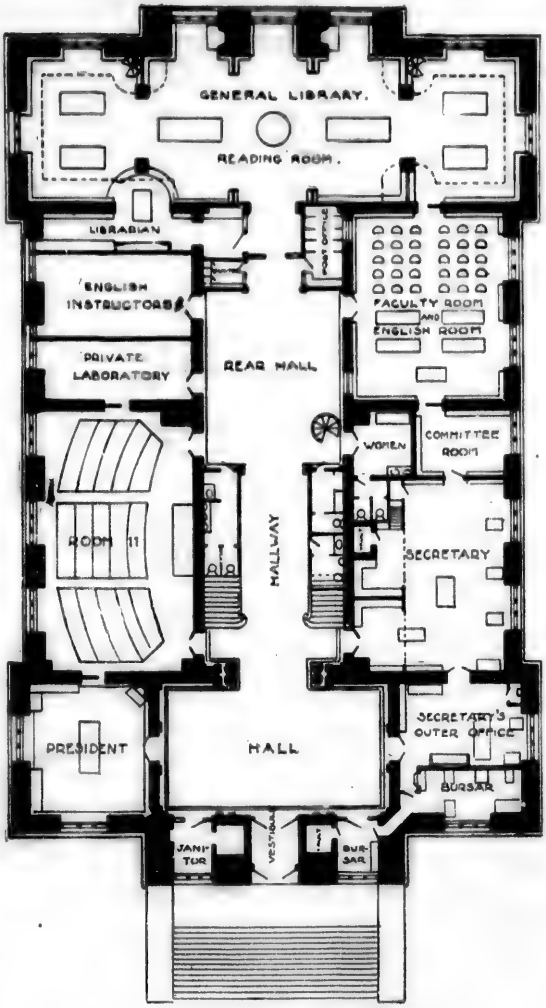
JAMES P. TOLMAN,
CHARLES C. JACKSON,
WILLIAM L. PUTNAM,
Members of the Auditing Committee.

BOSTON, December 7, 1898.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1898, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances. I have also examined the vouchers, and find receipts for all items, except the amounts paid out on the weekly pay-roll, and these amounts correspond with the pay-roll.

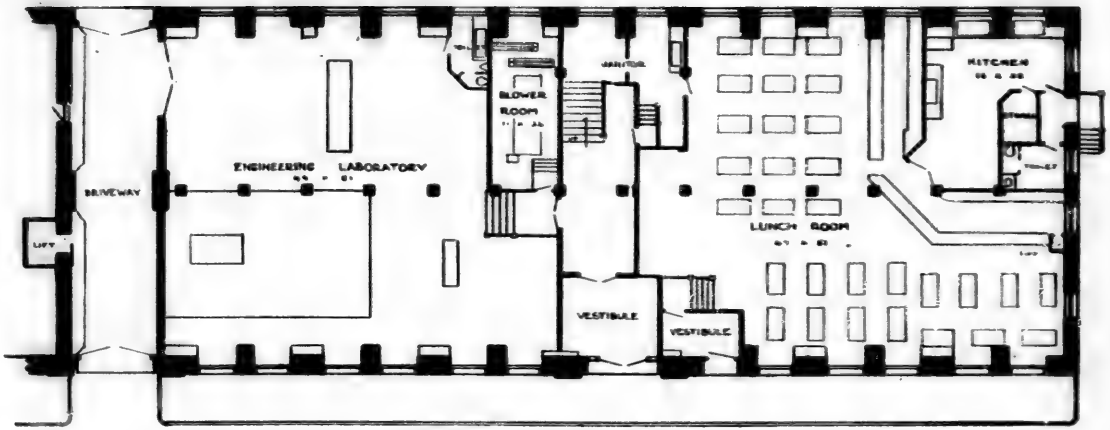
Yours truly,
EDWIN A. STONE,
Accountant.



ALTERATIONS IN ROGER'S BUILDING

ELEAZER B HOMER - ARCHITECT

PIERCE BUILDING



BASEMENT FLOOR PLAN

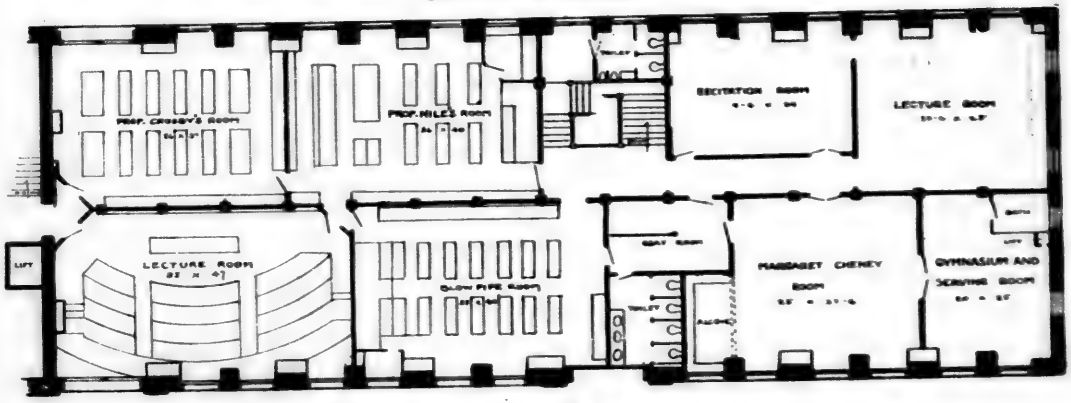
FIRE-PROOF BUILDING — MASSACHUSETTS INSTITUTE — TECHNOLOGY

ELEAZER B. HOMER ARCHITECT.

FIRE-PROOF BUILDING — THE MASSACHUSETTS INSTITUTE — TECHNOLOGY

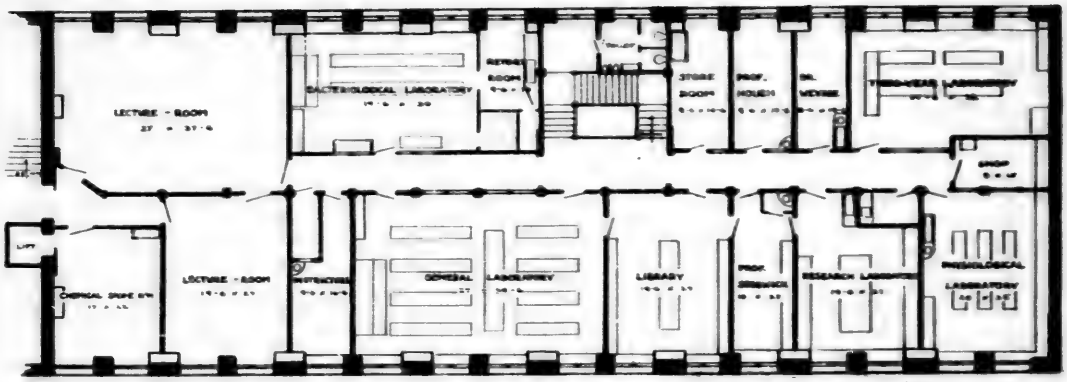
ELEAZER B. HOMER · ARCHITECT.

PIERCE BUILDING



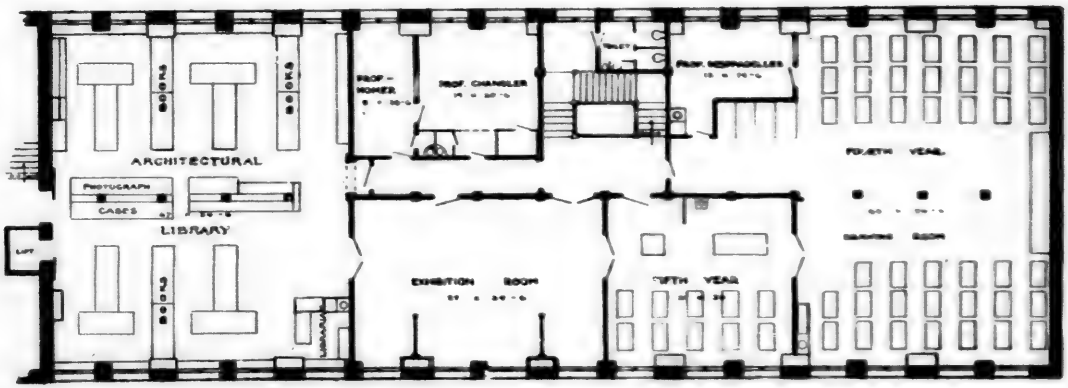
FIRST FLOOR PLAN.

PIERCE BUILDING.



SECOND FLOOR PLAN

PIERCE BUILDING



THIRD FLOOR PLAN

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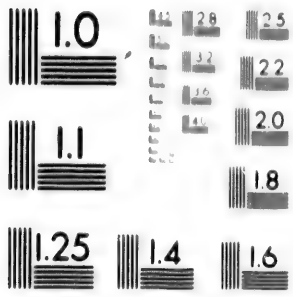
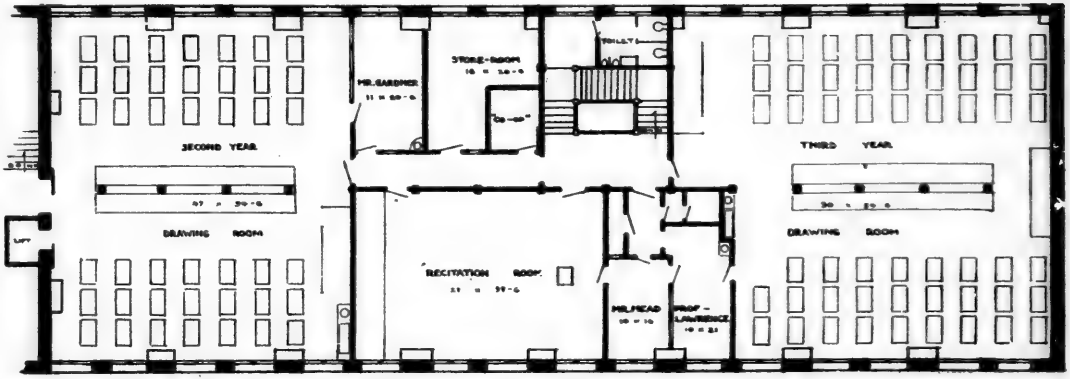


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

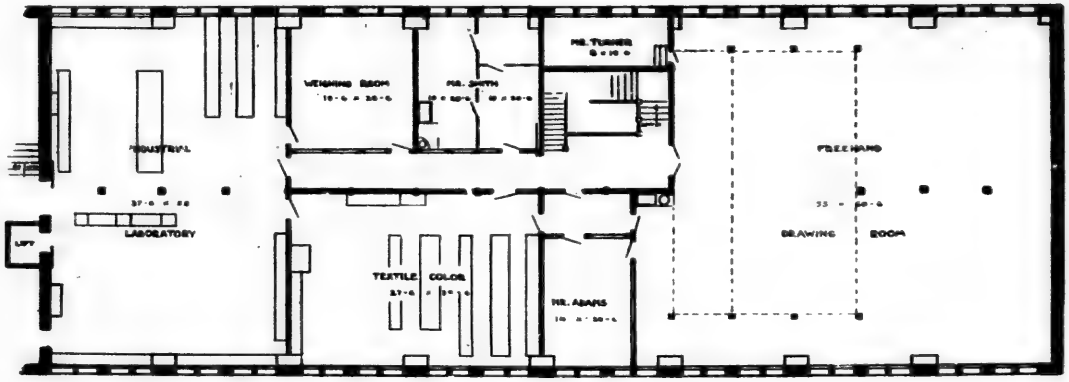
24:1

PIERCE BUILDING

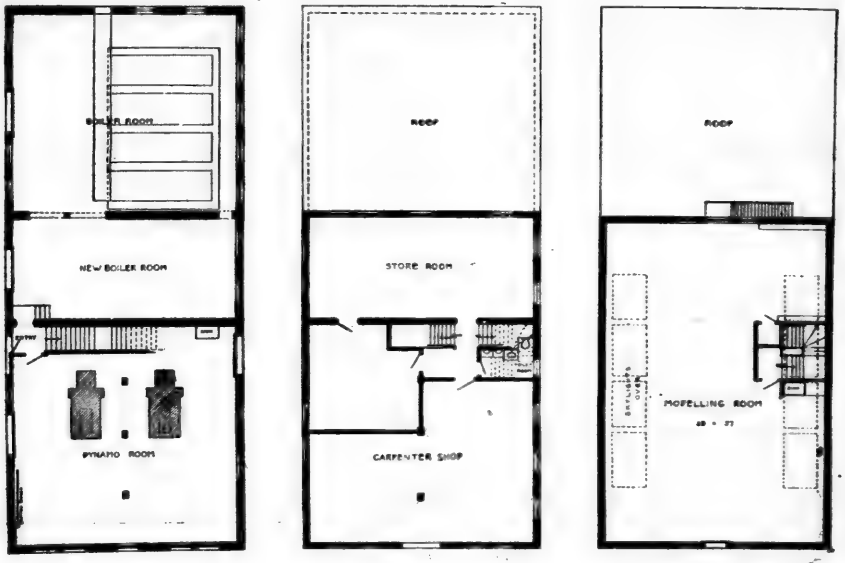


FOURTH FLOOR PLAN

PIERCE BUILDING



FIFTH FLOOR PLAN



FIRST FLOOR PLAN

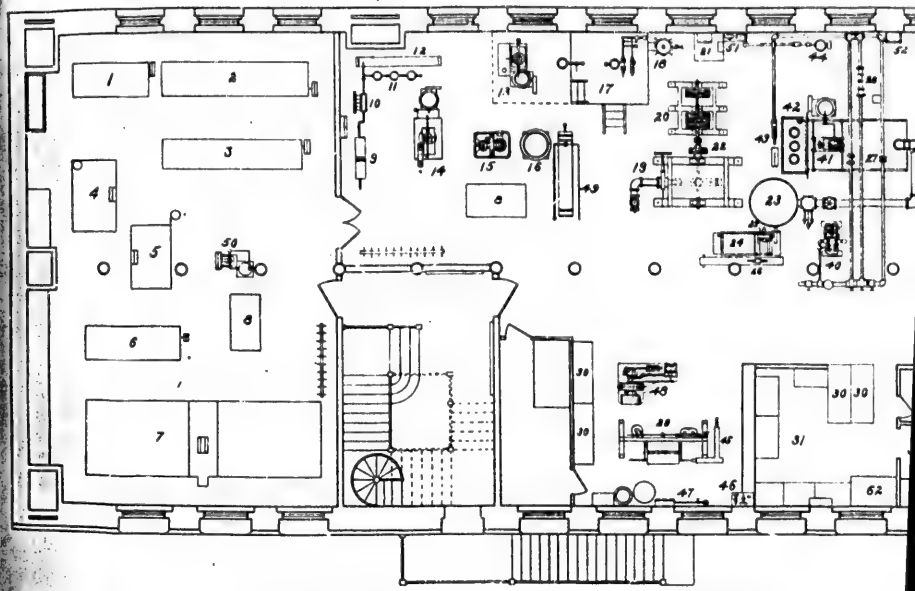
SECOND FLOOR PLAN

THIRD FLOOR PLAN

DYNAMO HOUSE - MASS. INSTITUTE OF TECHNOLOGY

ELEAZER B. HOMER - ARCHITECT

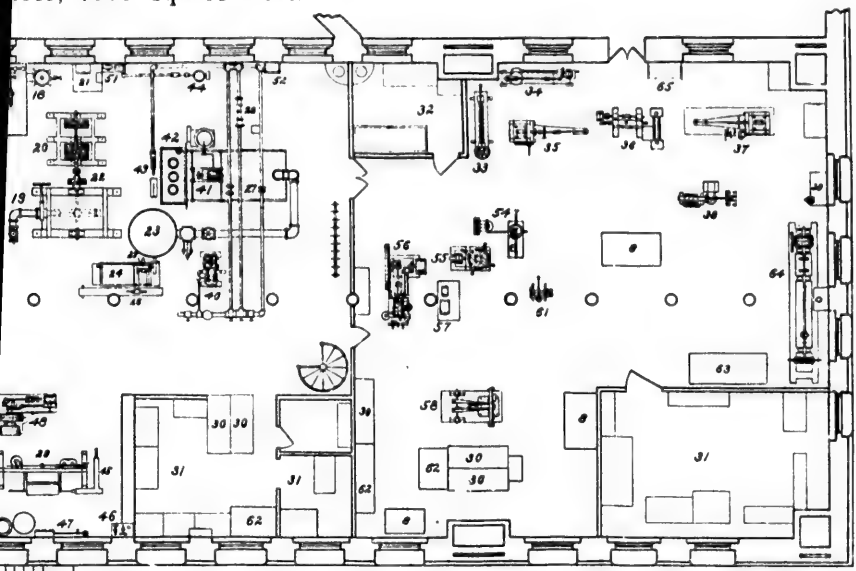
MASSACHUSETTS INSTITUTE OF T
ENGINEERING LABORATO
First Floor, 7500 Square Feet



1. Drawing frame.
2. Speeder.
3. Fly frame.
4. Carding engine.
5. Carding engine.
6. Spinning frame.
7. Mule.
8. Tables.
9. Flow of steam apparatus.
10. Superheating calorimeters.
11. Throttling calorimeters.
12. Condenser.
13. Continuous water calorimeter.
14. Hot-air engine (Ericsson).
15. Hot-air engine (Rider).
16. Supply tank for hydraulic ram.
17. Injector testing apparatus.
18. Apparatus for testing the force of the jet of an injector.
19. Pelton water-wheel.
20. Brake for Pelton water-wheel.
21. Mercury column.
22. Emerson power-scale.
23. Tank for hydraulic experiments.
24. Eight-inch weir.
25. Water meter.
26. Ejector.
27. Hydraulic apparatus.
28. Venturi meter.
29. Air-brake pumps.
30. Instrument cases.
31. Offices.
32. Room for mixing cement.
33. Machine for testing cement.
34. Machine for testing cement.
35. 50,000 pounds testing machine.
36. Cloth testing machine.
37. 100,000 pounds testing machine.
38. Wire testing machine.
39. Work bench.

INSTITUTE OF TECHNOLOGY.
RING LABORATORIES.

loor, 7500 Square Feet.



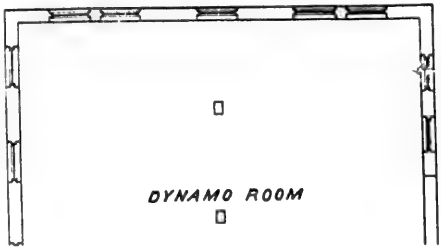
27. Hydraulic apparatus.
28. Venturi meter.
29. Air-brake pumps.
30. Instrument cases.
31. Offices.
32. Room for mixing cement.
33. Machine for testing cement.
34. Machine for testing cement.
35. 50,000 pounds testing machine.
36. Cloth testing machine.
37. 100,000 pounds testing machine.
38. Wire testing machine.
39. Work bench.
40. Water motor.
41. Hydraulic ram.
42. Adjustable weir and tank.
43. Apparatus for testing hose nozzles.
44. Hydraulic stand pipe.
45. Apparatus for testing anemometers.
46. Gauge tester.
47. Apparatus for determining the ratio of specific heats of gases.
48. Steam engine, 8 H. P.
49. Condenser.
50. Drosophore.
51. Water motor.
52. Seconds pendulum.
54. Gas explosion apparatus.
55. Abrasion machine.
56. Gas engine, 4 H. P.
57. Gas meters.
58. Lubricant testing machine.
61. Webber dynamometer.
62. Cases.
63. Repeated stress testing machine.
64. Dynamometer.
65. Scales for sealing weights.

MASSACHUSETTS INSTITUTE OF

ENGINEERING LABORA

Basement, 13,500 Square

1. Triple expansion engine, 150 H. P.
2. Dynamo, 800 lights.
3. Resistance box.
4. Belt transmission testing machine.
5. Prony brake.
6. Prony brake.
7. Prony brake.
8. Tables.
9. Carpenter's bench.
10. Lathe.
11. Condenser.
12. Steam engine, 16 H. P.
13. Duplex steam pump, 16" × 10½" × 18".
14. Gang pump.
15. Steam pump.
16. Centrifugal pump.
17. Pulsometer.
18. Main coils for heating and ventilating system.
19. Fan engine.
20. Cistern.
21. Weighing tanks.
22. Wrought iron tank for hydraulic experiments, 5 feet diameter, 27 feet high.
23. Prony brake.
24. Calibrated steel tanks, each 250 cu. ft. capacity.
25. Hydraulic stand-pipe, 10" diameter, 85 ft. high.
26. 3" water meter.
27. Mercury column.
28. Weighing tanks.
29. 12" weir.
30. Orifice tank.
31. Apparatus for testing pressure of air on surfaces.
32. Gauge testing apparatus.
33. Turbine wheel.
34. Hose nozzles.



35. 4-ft. weir.
36. Weighing tank.
40. Measuring tanks for steam jackets.
41. Surface condenser.
42. Weighing tanks.
43. Air pump.
44. Steam engine indicator tester.
45. Pipe bench.
46. Steam pump.
47. Steam pump.
48. Water wheel.
49. Cistern for oily water.
50. Emerson power scale.
51. Small torsion testing machine.
52. Hydraulic test-pump, 6,000 lbs. capacity.
53. Large weighing scales.
54. Lathe.
55. Bench.
56. Torsional shaft testing machine
58. Beam testing machine, 100,000 pounds capacity, 24 feet span.
59. Rope testing machine.
60. Emery testing machine, 300,000 pounds capacity.
61. Scale case for Emery testing machine.
62. Power hydraulic pump for Emery testing machine.
63. Wrought iron stack, 3 ft. diameter, 100 ft. high.
64. Arch testing machine.
65. Main coils for heating and ventilating system.
66. Fan.
67. Fan engine.
68. Machine for testing wear of brake shoes and of tires.
69. Machine for testing transmission of power by ropes. (English system.)
70. Oil testing machine.
71. Time test of timber beams.
72. Experimental pendulum governor.
73. Experimental fly wheel governor.
74. Beam testing machine, 10,000 pounds capacity, 14 ft. span.
75. Machine for testing coefficient of sliding friction.
76. Rotary pump.
77. Cistern connected by 12" pipe with cistern numbered 22.
78. Extension of cistern.
79. Two [illegible] pipe connecting cisterns 22 and 77.
80. Tandem compound engine, 200 H. P.
81. Condenser [illegible] air pump.
82. Pump.
83. Cistern for waste water.
84. Gas engine [illegible] H. P.
85. Prony brake [illegible] H. P.
86. Fan engine.
87. Fan.
88. Heating coils.
89. Portable forge.
90. Tanks and [illegible] weighing water.

INSTITUTE OF TECHNOLOGY.

RING LABORATORIES.

ent, 13,500 Square Feet.

for steam jackets.
r.

icator tester.

vater.
cale.
ting machine.
ump, 6,000 lbs. capacity.
cales.

esting machine.
achine, 100,(xx) pounds capacity, 26 feet

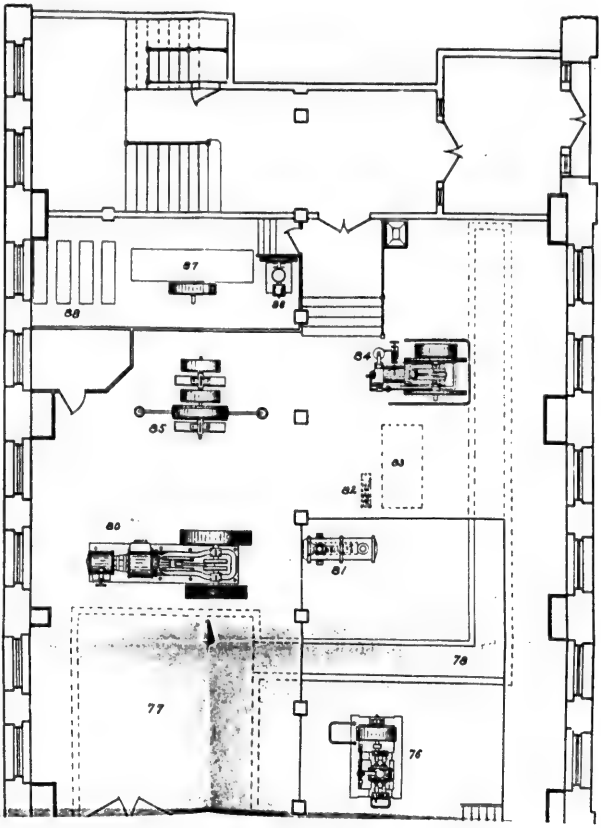
chine.
achine, 300,000 pounds capacity.
mery testing machine.
pump for Emery testing machine.
ack, 3 ft. diameter, 100 ft. high.
chine.
ating and ventilating system.

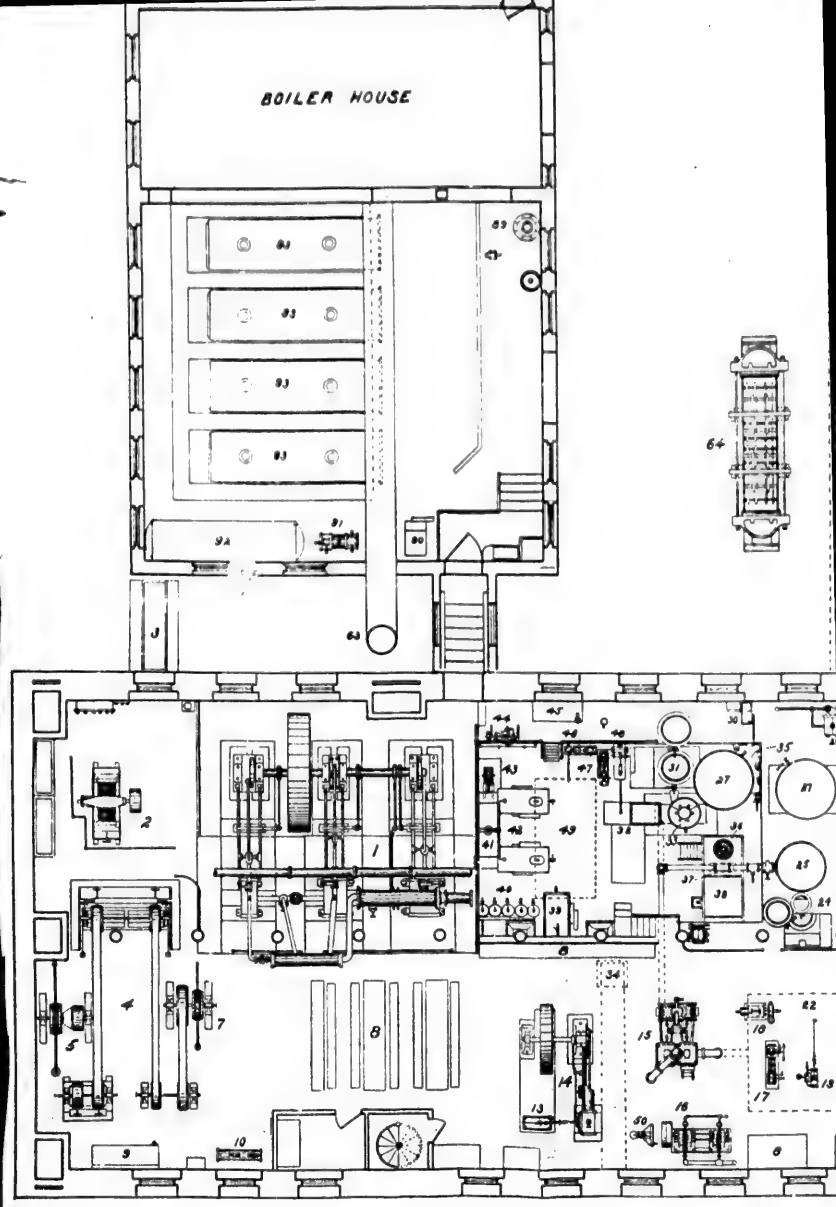
ing wear of brake shoes and of tires.
sting transmission of power by ropes.
tem.)
ine.
ber beams.
ndulum governor.
-wheel governor.
achine, 18,000 pounds capacity, 14 ft. span.
ng coefficient of sliding friction.

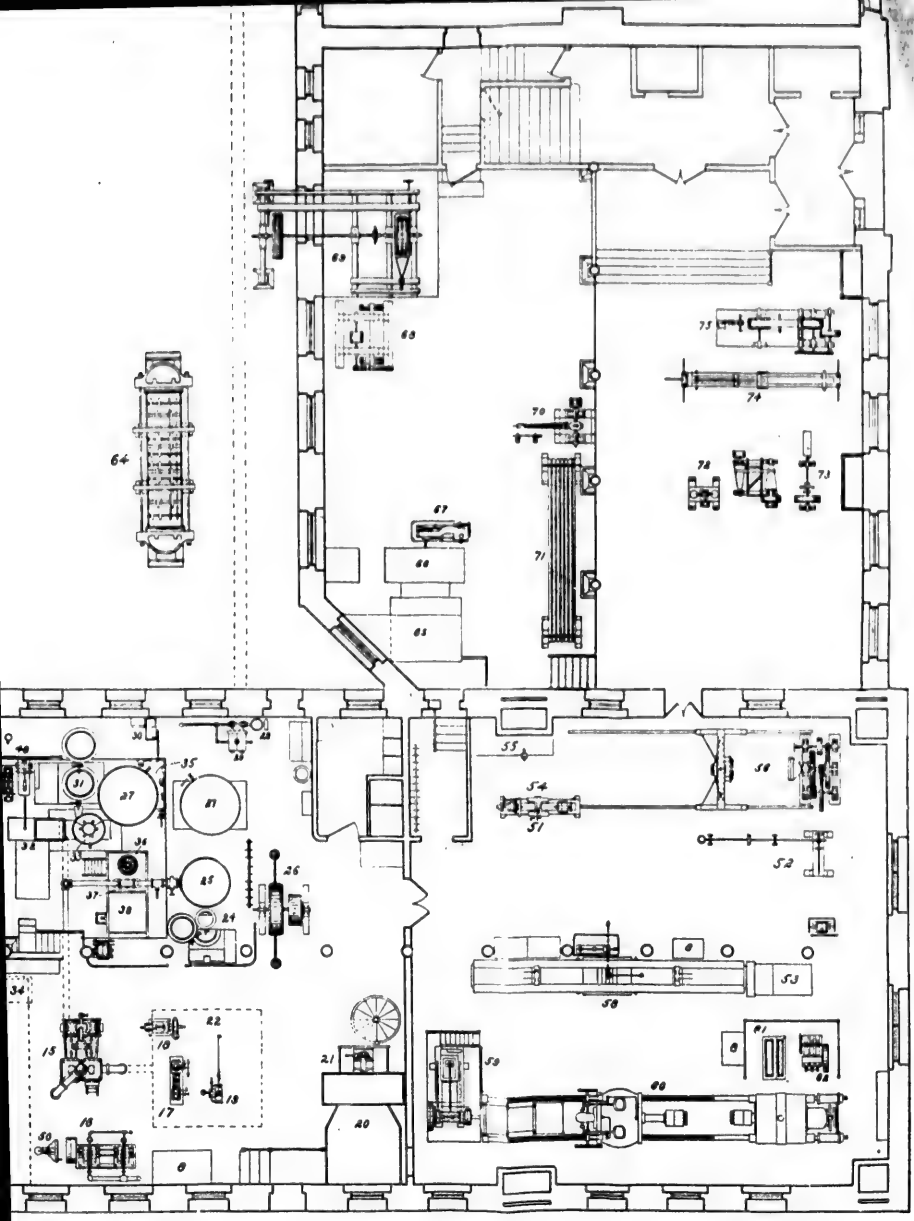
d by 12" pipe with cistern numbered 28.
ern.
connecting cisterns 27 and 77.
nd engine, 200 H. P.
ir pump.

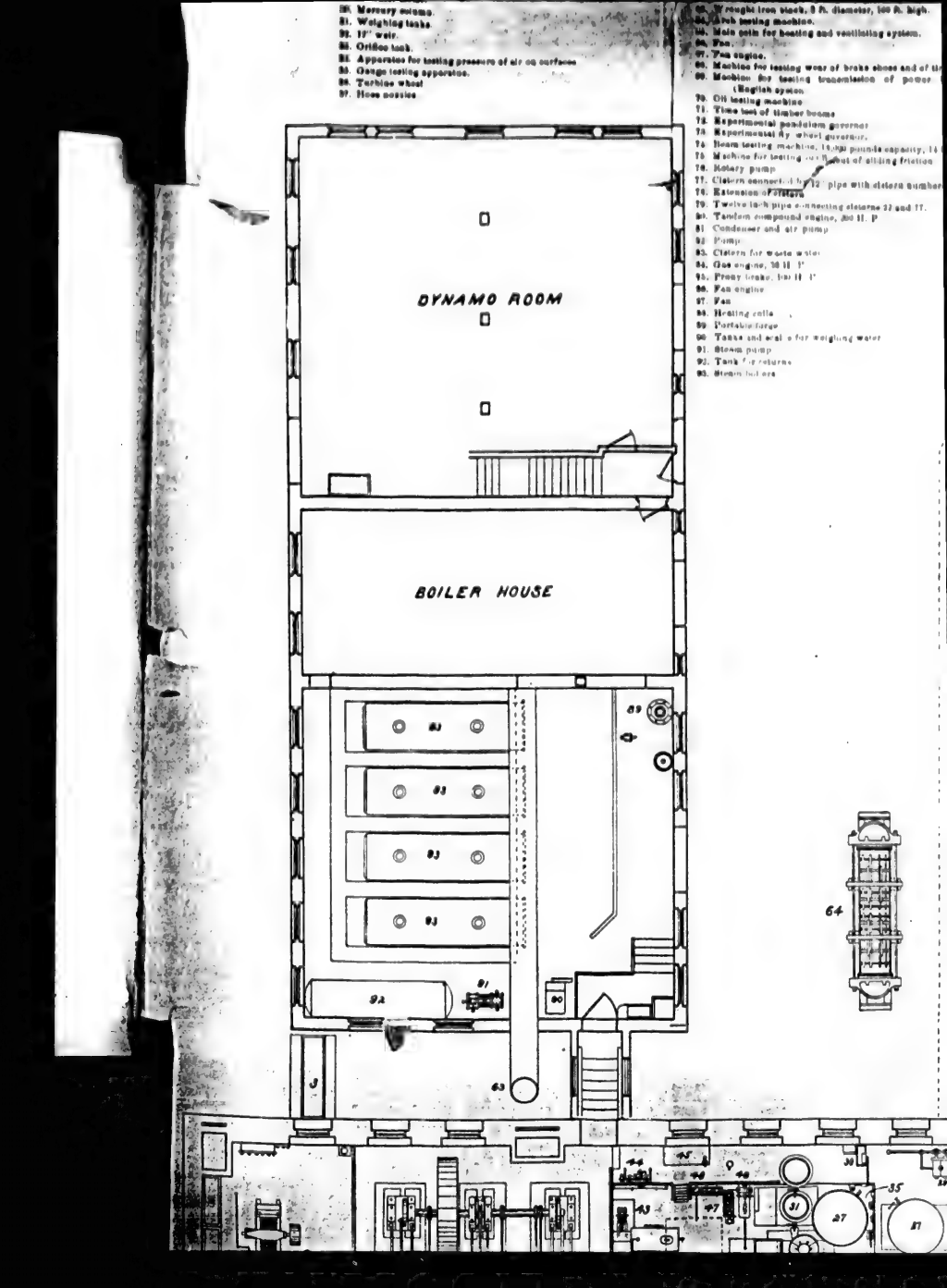
r water.
H. P.
H. P.

. . . weighing water.

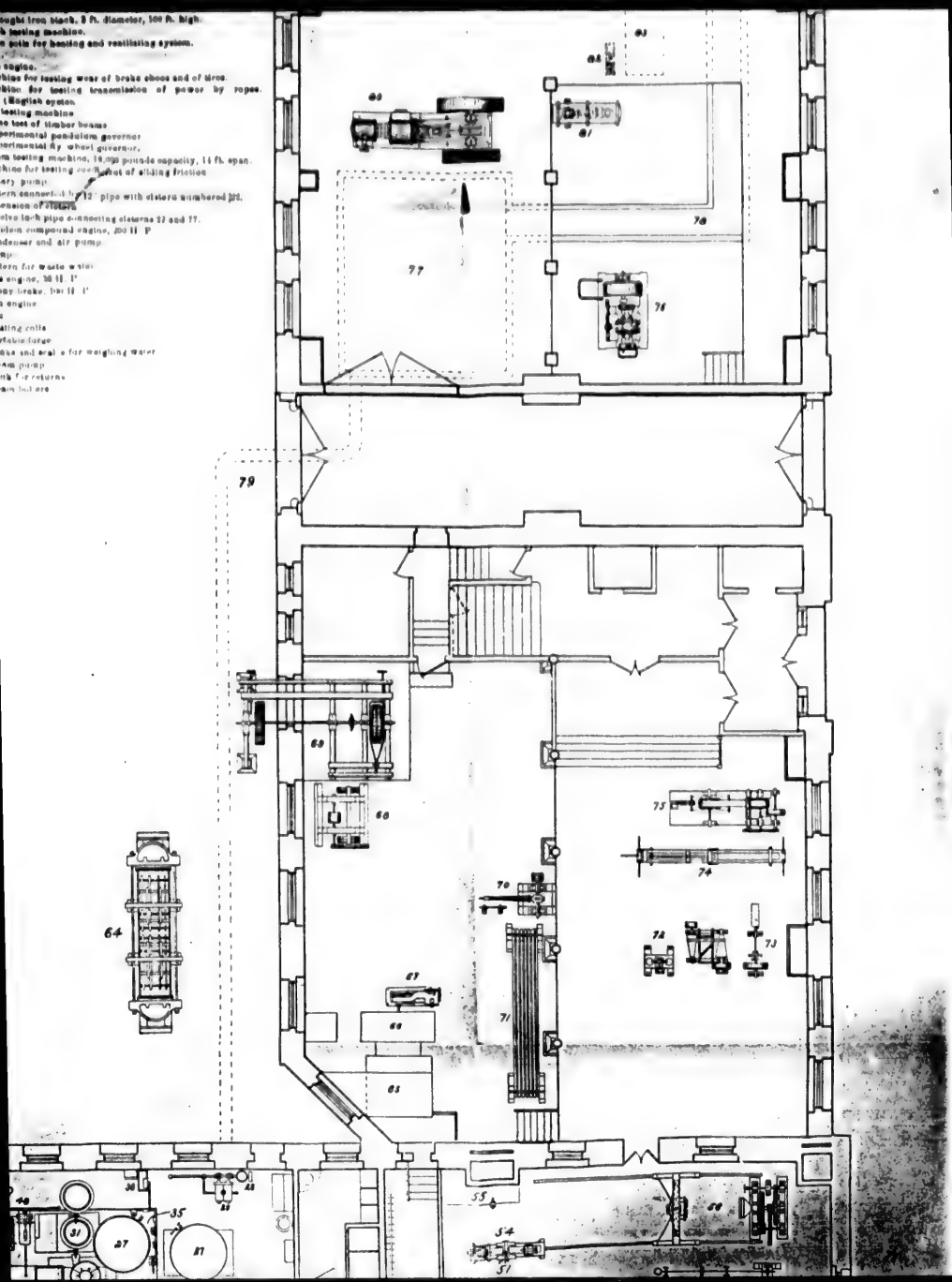



BOILER HOUSE




DYNAMO ROOM
BOILER HOUSE

ought iron block, 3 ft. diameter, 100 ft. high.
h testing machine.
n pots for heating and ventilating system.
engine.
hine for testing wear of brake shoes and of tires.
hine for testing transmission of power by ropes.
(English system.
testing machine
e test of timber beams
perimental pendulum governor
perimental fly wheel governor.
n testing machine, 10,000 pounds capacity, 11 ft. span.
hine for testing coefficient of sliding friction
ary pump.
ern connected by 12" pipe with cistern numbered 20.
ension of cistern.
ctive lock pipe connecting cisterns 22 and 17.
ndem compound engine, 200 H. P.
ndenser and air pump.
ip.
tern for waste water.
engine, 10 H. P.
ay brake, 100 H. P.
engine.
ating rolls
rtable forge.
ve and scale for weighing water
ng pump.
nk for returns.
ain boilers.



DYNAMO ROOM
BOILER HOUSE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER.

DECEMBER 13, 1899.

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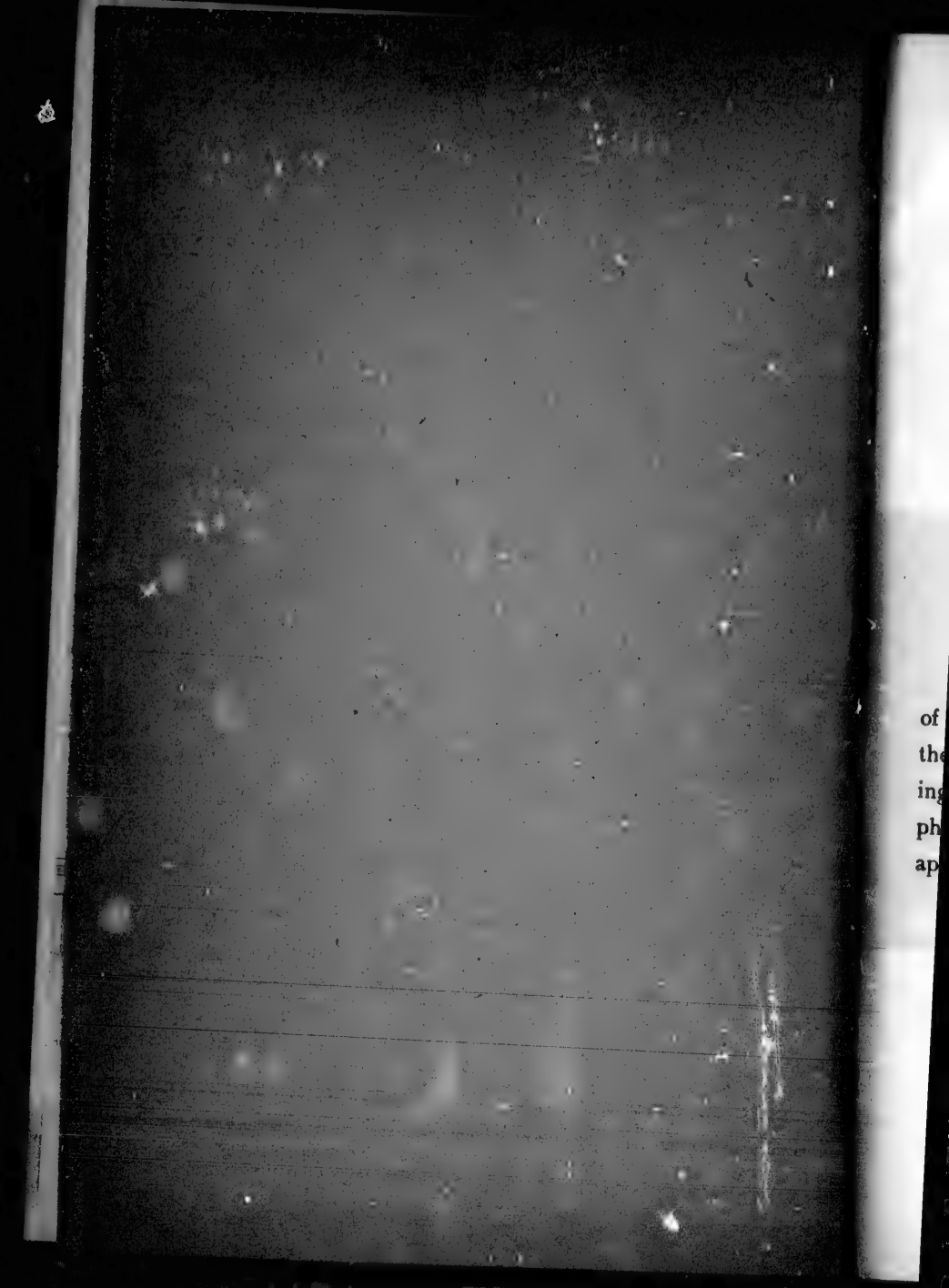

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The President's Report for last year included a list of military records of Institute men who had service in the Spanish War. In view of the impossibility of securing complete information at that time, a separate pamphlet has since been prepared, and will be mailed on application.

January, 1900.

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1900.

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Communications should be addressed to the Secretary of the Institute.
(See page 16.)

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To the Corporation of the Massachusetts Institute of Technology:

The inauguration of presidents in four neighboring New England colleges has been the occasion for *ex cathedra* utterances regarding the educational problems of the time. The new heads of universities have made solemn declarations of facts and principles, have stated their projects for college government and their conception of the great educational task which they are undertaking, and they have been favored with the advice of their fellow-presidents. The gatherings have been very large, and the whole educational corps has been animated with a sense of the intimate connection between all institutions of learning.

It seems fitting, in taking note of these events, to pass in review our own place in the educational work of the institutions of our country, and to see what share of the advice or comment we can apply to ourselves.

The following points are most worthy of our attention: a college president describes the older days, when the curriculum was intended to contain all the studies necessary for a liberal education, and draws a picture of the good fellowship of the students united in the accomplishment of a simple common task, and he speaks of the development of professional schools as the first of the disturbing elements which complicated the problem of college education. The study of principles and of the methods of inductive science, which the professional schools soon established as their chief work, awakened dissatisfaction with the college curriculum, and the impossibility of teaching everything in four years led to an elective system in colleges. The president of Yale gives a very frank statement of what he calls the dangers and evils of the present system of university instruction, and among them he places loss of *esprit de corps*, and he makes a very

interesting comparison between the academies at West Point or Annapolis and the modern college, giving the following description of the military and naval students: "A homogeneous body of men pursuing a common scheme of studies with a common end in view, and with rigorous requirements as to the work which must be done by each individual. In the modern American college the community of interest is less, the community of hard work is very much less. If this college spirit once passes away, the whole group of qualities known by the name of college democracy is in danger of passing away also."

While desiring to place before you the especial province of the school of applied science, and to make some comparison with that of the college, and using the words quoted as a text to introduce the subject, it would be ungenerous towards the courageous speaker not to point out that the above passage should be interpreted by the whole body of his discourse, and that it formed the prelude to admirable statements of projects for education in manhood and citizenship.

It is a part of our duty as the governing body of this institution to consider how our task and our opportunities may differ from those of other branches of higher education, and I think that we may begin by congratulating ourselves, not upon the superiority of our management, but upon the fact that our task is made a relatively simple one by the character of our students. They come to us with the purpose more or less well defined of taking some share in the achievements of this age of scientific progress; we educate them to this end, and send them out into the world equipped to do certain kinds of work. Whether such an education is not also a general and a liberal one is a question which will be alluded to later. Such a body of students is of necessity homogeneous, for the known fact that this course of study is arduous and demands a mind trained to mathematical discipline operates a selection before entrance, while a prescribed curriculum and a mature understanding of the application of the

studies to professional work lead the students to strive constantly towards a common goal.

Esprit de corps in college is succeeded in after-life by the professional spirit with its declared standard of honor and distinctness of purpose, so that in the civil as well as in the military professions men are bound together, and form a disciplined element in the community.

About ninety per cent. of our graduates are at present following some branch of applied science, and they constitute a considerable fraction of the body of professional men, thirty thousand or more, who are actively occupied with the work for which they were educated, and who are taking a large part in transforming methods of conducting old industries and enriching the country by introducing new ones, as has been done so successfully for chemical manufacturing in Germany. A glance at the present modes of directing work in construction, manufacturing, or engineering shows a strong contrast with the wasteful processes of the earlier part of the century, when the opportunities for a scientific education were rare.

The most important American scientific schools began to be established during the period 1835–1870, and they were the first for the Anglo-Saxon race, since those in England, except mining schools, have followed ours. Before that time some of our engineers were trained in France and Germany, most of them picked up what education they could in an office, and the West Point Military Academy was the only place where a systematic engineering education was given. Among the officers who left the army soon after graduation from West Point somewhat more than half took up some scientific occupation, and the proportion is somewhat larger after long military service, but it is a mistake to suppose that even in those early days a large proportion of our engineers received its admirable training.

The following are the numbers taken from General Cullum's biographical notices: Twelve hundred cadets were graduated at West Point between 1802 and 1843, and of these two hun-

dred and fourteen took up, during some period of their lives before 1867, often a very short time, some occupation related to civil engineering, becoming contractors, surveyors, railroad superintendents, teachers of mathematics, etc. It is plain that civil service was, as it should have been, usually subordinate to military duties, and I cannot refrain from speaking of the testimony borne to the value of the education at our national military academy by these biographies, and of the solemn impression left upon the mind by the perusal of the brief records of early death upon the field or of the long military service of twelve hundred cadets. It can only be compared to a visit to a soldiers' graveyard.

Any institution whose fixed course of studies maintains a high educational standard and strengthens a distinct purpose till it is settled for life is doing its true work as a professional school. The college of to-day seems to be accepting another task as its most important function: that of directing and giving play to scholarly and social tastes, and if we may trust the passage above cited, it is still in search of the most satisfactory methods.

The task of the university which undertakes to direct both systems is a very large one, and it may be well questioned whether it is not too large for a single administration. This opinion usually prevails in Europe, where the professional schools of science have been given an independent existence, and the present year marks an epoch in their development, since the great Polytechnic School of Charlottenburg has acquired the right to give the degree of Doctor of Philosophy. This step was taken by special intervention of the German Emperor after active opposition from the University of Berlin. The next step seems likely to be the attempt to establish a diploma for applied science, to which the university degree shall be preparatory.

In this part of our country, where the resources of the state are sparingly employed for higher education, the choice has not been free, and it has usually been a matter of necessity to utilize small funds to the best advantage by adding scien-

tific branches to college studies, and most of our scientific schools have so grown up under the shelter of a college. They have often been organized by men outside of the college, and in some instances their early history has not been a story of tender nurture by their alma mater, although at present our universities are proud of the growth of their schools of applied science and consider them an integral part of their system. Some of these schools have gained during their youthful experience a habit of taking care of themselves which has been decidedly to their advantage, since their faculties and trustees have acquired and maintained a considerable share of independence of action.

Our northwestern states have undertaken university education at public cost and on a liberal scale, and the universities have grown with great rapidity. All branches of higher education have been united under a single management, and the size, the strength, and the completeness of its university are matters of pride to the state. The unity of administration is promoted, at least in theory, by putting its control in the hands of a small board of regents appointed by the Governor or elected by the people. These are men of prominence whose influence is potent in presenting budgetary and other interests to legislatures. The president and faculty usually take the initiative in the appointment of professors and instructors. We find in the state universities departments of law, medicine, engineering, and more rarely of architecture, and frequently our own courses have served as models for teaching applied science. Some of the universities founded since 1865 by private endowment have also given from the beginning equal place to the applied sciences and to the academic departments.

Such have been the circumstances amid which our important scientific schools have been developed, and generally attached to a university. The pioneer among them, however, the Rensselaer Polytechnic Institute at Troy, has had no such support, and our own school with its larger programme has been fortunate in finding at Boston a centre of educational enterprise ready to aid and sustain an institution striving to

find new means of satisfying new demands. The founder of this school and his successors have laid these problems before you, the governing body. You have aided in the solution, and have helped to bring new questions before the whole community, and we are now enjoying the fruits of our independent existence and of the undivided attention of our Faculty and Government to an educational scheme more simple than that of our universities, while the reputation of the school is built upon the unhindered devotion of Faculty and students to a distinct and high professional ideal in education.

Some allusions have been made to the differences between foreign institutions and those of the United States, and it is worth while to say a few words regarding an American institution which scarcely exists elsewhere, namely, the trustees or lay government of educational establishments in this country. It is often supposed that all the oldest universities of Europe were in the hands of the clerks, as was the case at Paris and Oxford; but the earliest of all, in Italy, were schools of law and medicine, and were more democratic than any which have been known since. They were governed by students who hired their professors, told them what to teach, and decreed fines, and even the death penalty for neglect of duty. To-day in Europe the selection of teachers and the introduction of new studies are the province of the ministry of public instruction, and such questions are consequently dealt with by a permanent board of experts. In America groups of citizens have taken upon themselves to decide the most intricate educational questions; boards of trustees have received charters from the states conferring upon them various degrees of authority for the government of our universities. Usually they have complete control of financial affairs, but often the President and Faculty have considerable power in the appointment of teachers. These lay bodies confer degrees after examinations by the Faculty, and occasionally they have abused their privilege to confer the honorary degrees of M.D. and Ph.D. without examination.

The founders of colleges have been moved sometimes by

recollections of their scholarly days, but more often by the generous desire to provide for others privileges which were lacking in the arduous time of their youth. Men in the hurry of a business life have been mindful of the tastes and wants of the abstruse scholar; and schools of applied science have been founded and sustained by directors of our great enterprises who had little schooling themselves, or whose college course was restricted to classical studies. These citizens have well understood the needs of their time and country; in some cases they have formulated[1] them with signal distinctness and good judgment, and have called upon men of learning to carry out their plans. This conjunction of circumstances has been most favorable when innovators in education, like Rogers and Walker, have met men like John Cummings and others who have participated in the government of this school, and carried on an enterprise with faith and constancy through many evil days. Such governing bodies, unlike ministries of education abroad, have frequently been obliged not only to decide upon new courses of study, but also to pay for them from their own pockets, and each demand has met with a generous response not only from those of our own government and from our alumni, but also in a very remarkable way from men quite unconnected with the Institute who have put their wealth in your hands for distribution without reserve or restriction. It is easy to understand that the expenditure of funds under these conditions should be made with the shrewdness of the best business methods, and economy of production is one of the most notable features of American institutions of higher education, and is sometimes in strong contrast with those of Europe. Former reports have alluded to the attention which American methods of education in science have attracted in Europe, and again this year we have received visits and requests for information from persons charged with the establishment of schools of applied science in England, in Germany, and in Russia.

The citations in the beginning of this report have been

[1] See letter of Abbott Lawrence reprinted in "Engineering News," 1892, 460.

used to call attention to the contrasts which exist between the training of the scientific school and that of the college. During the thirty-four years which have elapsed since the foundation of this school two systems of education have progressed along divergent roads, and, curiously enough, it is now only a portion of the colleges and the schools of applied science which have been faithful to certain scholastic traditions which have been wholly or in part abandoned by many of the colleges. Professional requirements have compelled us to establish complete courses of graded and interdependent studies leading to a degree of bachelor of science, and, although we cannot say, as was said of the old degree of bachelor of arts, that it testifies to the attainment of all liberal knowledge, we can affirm that a student who has ascended step by step through such a course has received mental training which sends him far on the road to a liberal education, and that he has received the best guidance in the art of using one piece of knowledge to learn another.

The school of applied science is with reference to general studies intermediate in position between the college and those law and medical schools which require collegiate preparation for entrance. These professional schools can assume that their students have had the requisite general culture, and confine their teaching exclusively to professional subjects.

Our students are of collegiate age, usually with high-school preparation, and for them a strictly professional course would be too narrow. Our single degree of Bachelor of Science is intended to mean that a student has not only been taught facts and methods, but also that some attention has been given to the literary presentation of ideas, and that he has such an acquaintance with the range of modern thought as will show him where to look farther for general culture. No attempt can be made to enable him to explore in the original language those noble documents which have preserved the genius and learning of the past, and the great branches of ancient languages and literature so important in university studies find no place in our curriculum. Philos-

ophy is also omitted. The remaining groups under which university studies may be classed are taught to our students; namely, Modern Languages and Literature, including English; Mathematics; Chemistry; Physics; History and Political Science; Natural History; Architecture, and History of Art. The two latter subjects are treated as professional, and do not enter into all the courses. French and German are taught at the beginning of the course, so that the student can within the limits of technical studies make use of the languages as a Frenchman or a German does to acquire knowledge of facts; and such knowledge is required for use in many of the courses. The habit so acquired of freely using foreign languages opens the door to the enjoyment of modern literature. We have carefully guarded the time set apart for general studies like History, Literature, and Political Economy against the encroachments of professional subjects; but it is all too short to accomplish its object.

It must be frankly admitted that the old ideas about the relative dignity and precedence of studies have everywhere been abandoned, but questions of utility concerning the different branches of general studies are still under consideration, and these are more easily settled in a scientific school than in a college, because the declared purpose of the student is more definite. It is not, however, to these matters that reference was made in speaking of old traditions, but rather to the prescription of curricula made under the assumption that a teacher, or rather a council of teachers, can offer the best plans for a symmetrical course of study. The heads of some of our universities, after long trial of the elective system, hold exactly the opposite opinion regarding the needs and desires of their collegiate students, and the results of complete freedom of choice are spoken of with unqualified approval. Moreover, it is a significant fact that no active discussion of these diverging points of view is now going on in educational journals, and earnest convictions favored by reasons of convenience and popularity are spreading the elective system through our colleges. It is not within our province to criti-

cise this policy as applied to colleges, except in so far as we are called upon to defend our own system against the opinion that we are giving the narrower, and the college the broader education. The classical studies are not within the compass of a four years' course for a degree of Bachelor of Science, but the degree of Bachelor of Arts is equally narrow, for it may be taken with few scientific studies, and, in fact, mathematics, the experimental studies, and particularly physics, are neglected in colleges where the choice is free, in a way to show that in this age of scientific achievements intellectual curiosity does not run parallel with the progress of the times. Science was more popular with literary men during the last century, when every one desired to be encyclopædic, and a picture of the times is given by Voltaire's stay with the Marquise Du Châtelet at Cirey, where the lady was publishing the philosophy of Leibnitz, and her friend paid his court by editing Newton's Principia.

Athletic sports are ever growing in importance and do much to establish the popularity of our institutions of learning. A football game was this year offered as part of the inaugural exercises of a western college, and advertisements of preparatory schools show woodcuts of the pupils on horseback, in boats, or on the football field. Such sports can never receive the same attention in this Institute that they have at present in the more leisurely college life, but it may be explained that it is not the severity of our studies, but rather the time consumed in laboratory work and in drawing which makes the successful pursuit of competitive athletics difficult. Exercises which should be enjoined on a sedentary student, were it necessary to lay injunctions, are less important for ours, who are kept on their feet a considerable portion of the school hours, but every one knows that gymnasium work is restful as well as pleasant after other active occupations, and time and opportunities are offered for such exercises even with our present gymnasium, which is looked upon as a temporary one. Reference will be made later to a project for the erection of

a new building which will doubtless give great impetus to interest in physical exercises.

The popularity of college life which is taking young men from their homes to live in college towns depends greatly upon its social side, and in small towns where the population is collegiate the direction of the social element — taking the word in its broadest sense — presents great importance and considerable difficulty. Perhaps the best results for Anglo-Saxon youth have been obtained in England, where those unique associations of teachers and students which form the colleges within the university, although founded originally as charities for poor scholars, have now established a most agreeable and instructive, though somewhat expensive, mode of living for the wealthy. These units of the university organization offer some of the safeguards and pleasant features of family life, and they serve to promote friendly rivalry in athletic sports within the university. In America athletic events are rarer. They take large proportions between universities, and suffer from publicity and from the intervention of the newspaper, often a disturbing element in modern education. Students dwelling together have established clubs here and elsewhere, which have nothing classic about them except their Greek-letter names, and which do not fulfil the offices of colleges. But when not too elaborate they form pleasant associations of young men with tastes and occupations in common, and they are small centres in which good fellowship and attachment to their institution have active sway. Our own position is far removed from that of a collegiate town, because students coming from abroad soon come in contact with the larger society of a city, and this is facilitated by the fact that nearly half of our students live in their own homes and doubtless introduce their comrades to them. It may be added that this fact does much to lessen the temptations incident upon residence in a large city.

A change is now taking place in our northwestern states which will tend, if it spreads, to shorten the time of residence in colleges and in institutions like ours. The citizens of

those states demand and obtain in many of the large towns a gratuitous advanced course in their high schools intended to be nearly equivalent to the freshman and sophomore years of colleges. The students can thus remain in their homes to complete a course which they regard as final, or go to college only for the last two years. It does not yet appear that this change has had any effect upon the time of entrance of our northwestern scholars, and it is probably more than counterbalanced by measures taken to keep them at home. The University of Michigan makes a reduction of fees for citizens of the state, and the rates are so low in all the state universities that students are less disposed to go abroad. [California offers free tuition, with alluring advertisements of cheap board, and the tuition at other state universities is from $15 to $30.]

It is impossible for our endowed institutions to compete in the price of tuition with those supported by public funds, nor does our policy at present tend in that direction. We are endeavoring to use the funds placed at our disposal, not to make education cheaper, but to make it more valuable. Each yearly report gives an account of new men and apparatus added to our means of education, and last year it was stated that the cost of educating a student greatly exceeded his tuition fee, so that, if he looks upon his professional training as an investment which should bring in a quick return in the form of a professional salary, the investment may be considered each year a better one. It is fully appreciated that our high tuition fee would place our school beyond the reach of worthy scholars, were it not that generous donors have within the last two years added largely to the scholarship fund, so that now an income of about $24,000 can be applied to providing free, or partially free, tuition, while important sums in addition to that above named can be used to aid the graduate work of advanced students and teachers.

Although special foundations for professorships have been a common form of donation, sometimes an embarrassing one when the fund has become inadequate, it is very rare that funds have been made available for the benefit of

members of the instructing staff prevented from performing active duties as teachers. Mr. Augustus Lowell, who has long studied the needs of our Institute, having been a member of the Executive Committee since its establishment sixteen years ago, has this year taken the initiative in the establishment of a fund which is intended to provide for this want. His letter, accompanying a gift of fifty thousand dollars, expresses the wish that this sum shall be the nucleus of a fund of which the income shall be used for the benefit of the teaching staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the government may from time to time see fit to adopt. The donor has left the door open for others to associate themselves with him in this good cause by requesting that the fund shall have no personal designation, and it is earnestly hoped that the foundation proceeding from this generous nucleus will grow to be commensurate with that for scholarships.

It will be noticed that Mr. Lowell's gift is not called a pension fund, and that the only restrictions made upon its use serve to indicate a general purpose without hampering the freedom of action of our government. Our charter and our customs have given the Corporation, acting through its Executive Committee, larger powers than those possessed by most college trustees, and there is every reason to think that the Faculty will feel that their interests will be better cared for if no binding regulations are made at the present time. It does not seem necessary for us to make any rule until the fund has become larger, many cases have been dealt with, and customs established.

Steps have been already taken in other institutions to make the pension system part of the contract between government and teacher, in order to give greater security to the latter, and the idea is good; but the execution stumbles upon difficulties, chief among which may be named the impossibility of distinguishing by rule between qualities of work, and the difficulty of fixing for either side the time for terminating a service. The military system cannot be

applied in the same way to all colleges, because they differ greatly in the mode of appointment and continuance in office of their professors. Usually the question of the obligatory retirement at a certain age would be raised, and for us this would be a new issue which we are not called upon to deal with at present, and we may continue to hope that the Faculty will lose no professor until the professor has lost his faculties.

The Corporation has this year lost two of its members by death. Walbridge A. Field, Chief-Justice of the Commonwealth, was an *ex officio* member. Judge Field's high abilities and character would have been looked to for support in time of emergency; but, although he was acquainted with our work and took a friendly interest in it, his official duties prevented him from taking part in our deliberations.

Mr. Samuel Johnson was elected in 1897 a member of the Corporation and served on the Committee on Finance. His death deprives us of the counsels of a man whose fidelity and good judgment had caused his advice to be sought by many important enterprises of private and charitable business.

The Faculty has lost by death the head of the Department of Modern Languages, Prof. Alphonse N. van Daell, who was granted leave of absence to seek a health resort in Europe, and died at Wiesbaden after a very short illness, March 27, 1899. Dr. van Daell was a member of a distinguished Belgian family, and after accomplishing an extended course of study in the universities of Louvain, Liège, Paris, Bonn, and Berlin, he came to America in 1876, and held professional positions in our schools and colleges until, in 1886, he became director of the course in modern languages at the Boston High and Latin Schools. In 1889 he accepted the chair of modern languages in the Institute.

He made himself not only the master of our language, but also of our modes of thought, and took a keen interest in the affairs of his adopted country, so that he possessed rare qualifications for successfully imparting a knowledge of foreign languages and literature. Added to the accurate and wide

learning of a scholar was the intimate association with European life of an accomplished gentleman. His kindly interest in the students and his zeal and conscientious care made him an excellent teacher, while his genial qualities made his companionship agreeable and instructive to all who knew him, and his loss is deeply felt by his colleagues.

Walker Memorial Gymnasium.

A committee of nine members has been appointed by the Alumni Association to take steps to procure funds for raising a suitable memorial building for a gymnasium, and an encouraging interest in the undertaking has been shown by former students of the school, now numbering about six thousand. One of our principal buildings already bears General Walker's name, and the desire has been universal to perpetuate also in this new building the remembrance of his active and manly interest in the physical as well as the moral welfare of our students. It is hoped that the subscriptions will reach one hundred thousand dollars; and the plan of the committee will very probably include some accommodations for student reunions, and perhaps other social purposes.

The Buildings.

Considerable expense has been incurred this year in permanent improvements upon the Rogers and Walker buildings. Three fire-escapes of substantial design, in keeping with the outlines of the buildings, have been put up, and some changes of rooms are noted in the reports of departments.

A bronze tablet commemorative of the military service of General Walker was presented by the Commandery of Massachusetts of the Loyal Legion, and has been placed near the entrance door of the general library.

The principals and teachers of neighboring schools were invited to visit the Henry L. Pierce Building on the 14th of February, and the visitors were shown the rooms devoted to

architecture, biology, geology, and industrial chemistry, in each of which are new and interesting accommodations for science teaching.

Telephones. The Bell Telephone Company has again shown its consideration for our work in pure science as an ally to industry, and we owe to its liberality an important telephone service between our different buildings. The somewhat complicated system, with twenty-seven stations, was planned by Mr. Hammond V. Hayes, electrical engineer of the company, and by Professor Puffer, and we owe thanks for their good offices as well as for the very generous favor extended to us by the Company.

Paris Exposition.

The Institute has been invited by the United States Commission to take part in the educational exhibit at Paris in 1900. Cornell University and the Institute are asked to represent engineering and architecture.

The Commission has made a special allotment of wall space in response to our request for place to display architectural drawings, and although it is not as large as desired, it is hoped that a proper exhibit can be made. Photographs with explanatory text have been prepared to show the scope and methods of instruction at the Institute, and special attention has been paid to architecture and the engineering departments in order to meet the wishes of the United States Commission.

The Library.

This is the tenth report since the establishment of the office of Librarian, and it may not be inappropriate to preface it with a brief review of the growth of the Library during these ten years. Dr. Bigelow reports that until the year 1889 such books and periodicals as were needed were purchased by the professors as part of the laboratory supplies of their respective departments. There was no uniformity as to the arrangement or cataloguing of the books, and nothing was done to prevent duplication. The receipt by the Chemical

Department of the library of Professor Nichols led to an arrangement being made whereby Mr. C. W. Andrews, Instructor in Chemistry, was engaged to spend his summer vacation in cataloguing the library of that department. Later he accepted on similar terms the task of making a general catalogue of all the books in the Institute — an undertaking which undoubtedly seemed the more necessary because of the recent receipt of a large and very valuable collection of books and pamphlets from Mrs. W. B. Rogers. Finally, in 1889 Mr. Andrews was appointed Librarian of the Institute. After a careful examination of the different systems in use, the Dewey system of decimal classification was adopted and applied to all the books. In order to prevent unnecessary duplication a rule was adopted that all new books should be purchased through the librarian; but several copies of the same book may be required for use in different departments.

When Mr. Andrews entered upon his new position the Institute possessed about 17,545 volumes and perhaps 8,000 pamphlets, distributed in ten libraries, of which only five had been catalogued. From this time on, the new books were catalogued when received, and by devoting his summers to the work Mr. Andrews succeeded in completing the catalogue of old books in 1893. The amount of work and the disadvantages under which it was done can be fully appreciated only by one who has attempted a similar task. The room provided for an office was very small and inadequate, and the duties of the librarian included everything from the work of office boy upward, except a certain amount of routine clerical work that was intrusted to an assistant. The only aid received from attendants in the departmental libraries was in copying the cards for the departmental catalogue, mostly done by hand. The General Library was then simply a place where first-year students might study their lessons, and where books could be stored that were not wanted elsewhere. The other libraries, although small, contained many books and sets of periodicals of great value.

At the end of the fiscal year 1898–99 the total number of

volumes in the libraries of the Institute exceeds 50,000 and the total value of the libraries is estimated at $112,000. The librarian has an office which, although small, is sufficiently commodious for the ordinary work. He has an efficient assistant, who is a trained cataloguer and is capable of undertaking any part of the work that may properly be delegated to an assistant. Three of the attendants in the departmental libraries are also skilled in cataloguing, and do that part of the work for their respective departments under the supervision of the librarian. All cards added to the general or the departmental catalogues are typewritten. The libraries of the departments of English, Modern Languages, and Military Science having been incorporated with the General Library, and the whole housed in a suitable room, the General Library is much more nearly what its name implies, although much is still to be desired in that direction.

An examination of the following table will show that the growth of the libraries in number of volumes has been steady and continuous. The average annual increase for the ten years is 3,260 volumes. The minimum is 1,867, and the maximum 4,080, occurring in the first and second years respectively.

GROWTH OF THE LIBRARIES DURING THE TEN YEARS FROM 1889 TO 1899.

YEAR.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Net accessions, vols.	. . .	1867	4080	3320	3607	4045	3190	3387	2974	2690	3438
Total vols., Sept. 30	17545	19412	23492	26812	30419	34464	37654	41041	44015	46711	50149

The separate contribution of each department toward the total growth is shown by the table which follows:

GROWTH OF THE LIBRARIES BY DEPARTMENTS DURING THE TEN YEARS ENDING SEPT. 30, 1899.

LIBRARIES.	ANNUAL INCREASE IN VOLUMES.		
	Average.	Maximum.	Minimum.
History and Economics	653.5	963	448
Engineering	641.9	900	233
General[1]	421.8	720	115
Physics	396.0	587	99
Chemistry	380.0	476	272
English	203.7	479	89
Architecture	158.7	265	61
Mining	156.4	271	106
Biology	133.5	194	56
Geology	101.0	212	22
Margaret Cheney Room	13.9	36	0
Total	3,260.4		

Owing to differences in the rate of growth the relative sizes of the libraries have changed considerably during the ten years. In 1889 the largest library was the Chemical, with 3,756 volumes, and the one next in size was the Library of History and Economics, having 2,969 volumes. Now the Library of History and Economics is the largest, having 9,504 volumes, and the Chemical Library with its 7,556 volumes is reduced to fourth place, while the Engineering Library is next to the largest, having reached the considerable size of 8,822 volumes. These departmental libraries still maintain their place, however, among the leading technical libraries of the world.

Our system of departmental libraries is a product of the natural growth of the Institute, having arisen by the accu-

[1] Until 1897 the libraries of Mathematics, Military Science, and Modern Languages were regarded as a part of the General Library, as in this table, while the English Library was regarded as separate.

mulation of books purchased from time to time as they were needed for the use of the various departments. When it began to be realized that in these scattered collections we possessed a library of considerable size and of great value, the departmental system had become so firmly established and was found to meet the needs of the Institute so well that there was little thought of making any change.

This system was adopted from the start by Johns Hopkins University and the University of Chicago, and within the last few years the principle has been applied cautiously and to a limited extent in some of the other leading universities which formerly had simply one central library. Thus at Harvard, while the great departments of the university like the Law School, Divinity School, and Zoölogical Museum have long maintained separate libraries, it is only recently that sixteen "Laboratory and Class Room Libraries," aggregating 20,500 volumes, have been established for the various departments of Harvard College. The only trace of this system at Yale appears to be in the library of the Sheffield Scientific School, consisting of about 5,000 volumes, largely mathematical. From this there is set apart a special Chemical Library, a small library of History and Political Science, and private technical libraries on the subjects of Geology and Mineralogy. In his report for 1897 the librarian of Columbia University states that departmental libraries are about to be established for the departments of Zoölogy, Mineralogy, Geology, Palæontology, and Mining. At Cornell University about 15,000 volumes out of a total of 196,000 in the general library are deposited in the seminary rooms and department and laboratory collections.

The libraries of five of the great technical schools of Europe, as classed in Minerva,[1] surpassed ours in the number of books in 1897–8: Hannover, 145,000 volumes; Vienna, 81,044; St. Petersburg, 75,500; Buda Pesth, 55,682; Aix-la-Chapelle, 48,000.

[1] No statistics in regard to libraries are given for Charlottenburg nor the schools of London and Paris.

During the year 1898–9 the following additions were made to the library:

By purchase	1,621
From the bindery	878
Gifts	1,616
Total accessions	4,115

After deducting books purchased to replace lost volumes, books counted twice, etc., the net accessions are 3,438 volumes, 527 pamphlets, and 24 maps. The distribution of these accessions and their cost among the different departments is exhibited in the table below:

TABLE OF NET INCREASE DURING THE YEAR 1898–99, SHOWING THE COST OF THE SAME, AND TOTAL CONTENTS AND ESTIMATED VALUE OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1899.

Libraries.	Net Increase.				Total Contents.		
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets & Maps.	Estimated Value.
General Library. (General	249	143	.....	$80.11	4,254	3,566	
General Library. (English	163	1	.....	181.77	2,535	38	
General Library. (Mod. Lang.	48	.....	.....	110.32	642	18	
General Library. (Military Sci.	6	.....	.....	5.35	142	6	
Totals Gen. Lib.	466	144	.....	$377.55	7,573	3,628	$10,570
Architecture	223	10	.....	794.82	2,448	210	18,402
Biology	114	15	.....	165.64	2,185	419	4,890
Chemistry	328	31	.....	557.36	7,556	1,546	16,932
Engineering	900	184	23	1,488.59	8,822	3,581	20,123
Geology	93	4	.....	107.14	1,931	822	4,412
History & Economics,	496	44	1	525.06	9,504	3,165	14,988
Mathematics	258	11	.....	652.06	906	174	2,028
Mining	271	66	.....	274.92	2,325	407	5,196
Physics	272	18	.....	421.42	6,283	707	13,964
M. Cheney Room	17	.....	.....	.....	616	13	1,357
Totals	3,438	527	24	$5,364.56	50,149	14,672	$112,866

The value of the libraries was calculated as follows: Architectural Library at $7.50 per volume, Library of History and Economics at $1.50, General Library at $1.30, all other libraries at a general average of $2.20, and all pamphlets at 20 cents. These figures were adopted after a careful study of the cost of total accessions by purchase and binding from Oct. 1, 1890, to Sept. 30, 1898.

We are now receiving 840 periodicals and other serial publications at a total cost to the Institute of about $[illegible],000 per annum, as is set forth in detail in the following table:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1898–99.

LIBRARIES.	NUMBER RECEIVED.					ESTIMATED COST.			
	Gifts.	Paid by Dept.	PERIODICAL ACCOUNT. Exch.	Subs.	Totals.	Paid by Dept.	PERIODICAL ACCOUNT. Exch.	Subs.	Totals.
General . .	32	1	16	26	75	$6.00	$38.40	$84.47	$128.87
Architecture,	2	2	7	30	41	4.40	16.80	178.41	199.61
Biology . .	15	6	8	37	66	21.10	19.20	230.94	271.24
Geology . .	16	1	8	5	30	2.50	19.20	20.95	42.65
Chemistry .	86	14	13	39	152	42.95	31.20	185.53	259.68
Engineering,	48	24	56	54	182	51.12	134.40	233.41	418.93
History and Economics,	50	28	5	68	151	61.19	12.00	225.79	298.98
Mathematics,	. .	. .	2	13	15	. . .	4.80	52.93	57.73
Mining . .	10	3	21	22	56	4.95	50.40	77.87	133.22
Physics . .	9	13	28	29	69	9.49	67.20	146.44	223.13
Lowell School of Design .	. .	. .	. .	3	3	. . .	. .	10.00	10.00
							$393.60	$1,316.74 393.60	
Totals . .	268	82	164	326	840	$203.70	. . . .	$1,840.34	$2,044.04

The remaining statistics of the libraries for the year may be tabulated as follows:

SUMMARY OF EXPENDITURES FOR THE LIBRARIES, EXCLUSIVE OF SALARIES.

Books and binding	$5,364.56
Periodical account	1,933.02
Expense account	233.79
	$7,531.37
Less receipts from sale of duplicates	90.16
Total	$7,441.21

OTHER STATISTICS OF THE LIBRARIES.

Number of orders issued for purchase of books	1,376
Number of order slips returned to heads of departments as duplicates,	191
Number of the same reordered	14
Suggestions for purchase sent to heads of departments	1,743
Number of the same approved	462
Books received for inspection	281
Number of the same purchased	63
Number of orders for binding and lettering	1,278
Cards added to the general catalogue	2,811
Total number of cards in general catalogue	44,953
Books and periodicals borrowed for home use:	
General Library	877
Biological Library	215
Chemical Library	1,938
Engineering Library	2,270

The statistics in regard to the borrowing of books represent only a part of the use made of the libraries. Not only have a large number of books been borrowed from the libraries not mentioned in the list above, but in all the libraries many books are being used constantly for reference without being taken from the room, and no record is kept of the books used in this way.

During the year considerable progress has been made upon a subject catalogue of the Chemical Library, although the only time available for this purpose has been what the assistant in charge could spare from her other work. A beginning has been made on subject catalogue of the books on public health and sanitary engineering in the Engineering Library by the assistant in charge of that library. The plan is to make ultimately a complete subject catalogue of all the books on that subject in the Institute, this being especially desirable

because the books are divided between the Engineering, Chemical, Biological, and Architectural Libraries. The subject entries are made upon colored cards to distinguish them readily from the author and title entries, and they are filed alphabetically in the general catalogue with the other cards. When the plan has been carried out, it will be possible for any one wishing to look up the literature to come to the general catalogue and there in one alphabet find under the subject headings references to all books on these subjects in any of the libraries of the Institute. Copies of the subject cards will also be filed in the catalogues of the libraries in which the books are placed. These beginnings are but part of a plan to make the general catalogue finally a complete dictionary catalogue, both by author and subject, of all the books in the libraries of the Institute. As an author catalogue it is complete, but the completion of the subject part is an ideal which it will take many years to attain with the force at present at the disposal of the Librarian.

Of the gifts received during the year special mention should be made of the following: — a number of reports and public documents from Senator George F. Hoar and Hon. Samuel W. McCall; 194 volumes, chiefly on engineering and mining, belonging to the late Gorham P. Faucon and presented to the Institute by his mother; from Mrs. Sarah A. Floyd, 11 volumes on chemistry, from the library of her son, Charles W. Floyd; from Professor Richards, Rziha, Lehrbuch der gesammten Tunnel-Baukunst, 2 vols.; from the authors, Report on the Purification of the Ohio River Water at Louisville, Kentucky, by George W. Fuller, and Matter, Energy, Force, and Work, by Prof. S. W. Holman; from Professor Burton, Flammarion, Popular Astronomy, Whymper, Travels among the Great Andes, Muster-Blätter f. d. topographischen Arbeiten d. k. preuss. Landes-Aufnahme, Compte rendu de la Congrès internationale des Sciences géographiques, 1891; from Mr. Samuel Cabot, Vignola, Règles de cinq Ordres d'Architecture. Mrs. Henry Draper has sent us the third volume of Sachs, Modern Opera Houses, and she has continued her subscrip-

tion to Comptes rendus de l'Academie des Sciences de Paris. Mrs. W. B. Rogers has continued her subscription to Nature and Popular Science Monthly. Professor Runkle presented the library during the summer with 34 books and 14 pamphlets, in addition to the most notable gift of all; namely, the greater part of his mathematical library, which was deposited with the Institute during the summer of 1898. This library was fully catalogued before being placed upon the shelves, but as it was at first received as a deposit, and not a gift, it was not entered in the record of accessions. These books are kept together on special shelves in the new and well-equipped room provided during the year for the Mathematical Library.

Changes in the Faculty and Corps of Instruction.

Dr. Adolph Rambeau, Ph.D., has been appointed Professor of Modern Languages to fill the vacancy caused by the death of Professor van Daell.

Dr. Rambeau is of Huguenot descent, and belongs to a French family which fled to Geneva after the revocation of the Edict of Nantes, and afterwards settled in Germany. His collegiate education was at Wittenberg, where he was grounded in Latin, Greek, and mathematics, and his university studies were in classical and Germanic philology, and especially in Romance languages and literatures. He pursued these studies from 1871 to 1874, in 1876, and during different periods after 1876, at Halle, Marburg (Ph.D., 1877; licentiate, 1879), and Paris. Four years, 1874–78, were spent in travelling in southern Europe, Egypt, Algiers, and the United States, and the Italian, Spanish, and English languages were mastered. From 1878 to 1879 he was instructor in the Romance-English Seminary of the University of Marburg, and lectured upon Chaucer and the English literature and language. From 1879 to 1892 he held similar positions at colleges, finally with the honorary title of professor, in Strasburg, Wiesbaden, and Hamburg. In 1891 a linguistic exploration

was made in northern France. In 1893 Dr. Rambeau accepted a call to Johns Hopkins University; in 1894 he became Associate Professor of Romance Languages. He taught French and Italian languages and literatures, and lectured in the graduate department upon comparative phonetics and French pronunciation, and also taught Spanish under the auspices of the public school teachers' association of Baltimore. Dr. Rambeau is one of the editors of a linguistic and pedagogic periodical, and has published a scientific work upon Parisian pronunciation, Chrestomathie Française, also some articles upon Egypt and the East; literary and philological studies upon the "Chanson de Roland," Chaucer's "House of Fame," and Dante's "Divine Comedy"; an edition of old French dramas by Adam de la Hale; original studies and books for the use of students and teachers; and a great number of articles in American and European philological journals.

Dr. Arthur A. Noyes has been appointed Professor of Theoretical and Organic Chemistry. Dr. Noyes completed our course in Chemistry in 1886. He was appointed Assistant in General Chemistry in 1887, Instructor in Analytical Chemistry in 1890, Instructor in Organic Chemistry in 1892, Assistant Professor of Organic Chemistry in 1894, and Associate Professor of Organic Chemistry in 1897.

Assistant Professors Jerome Sondericker, Allyne L. Merrill, and Edward F. Miller, of the Departments of Applied Mechanics and Mechanical Engineering, have been appointed Associate Professors of Applied Mechanics, Mechanical, and Steam Engineering respectively. Professor Sondericker was appointed Instructor in Applied Mechanics in 1885, and Assistant Professor of Applied Mechanics in 1890. Professor Merrill was appointed Assistant in Mechanical Engineering in 1885, Instructor in Mechanical Engineering in 1887, and Assistant Professor of Mechanism in 1891. Professor Miller was appointed Assistant in Mechanical Engineering in 1886, Instructor in Mechanical Engineering in 1888, and Assistant Professor of Steam Engineering in 1892.

First Lieutenant James Hamilton has been detailed by the War Department and appointed Assistant Professor of Military Science in consequence of Captain Bordman's resignation to become Adjutant of the 26th Infantry, now in service at the Philippine Islands. Lieutenant Hamilton was graduated from West Point in 1890, and has recently resigned from military service and taken up the practice of law.

Mr. Joseph Willard has been appointed Lecturer on Business Law, and will take up the course formerly given by Mr. Brandeis.

Messrs. Carleton A. Read, Frederic H. Keyes, Alexander W. Moseley, and Frederick A. Hannah, Instructors in Mechanical Engineering, have resigned in consequence of favorable opportunities elsewhere. Mr. William J. Drisko, Instructor in Physics, has been appointed Professor at Colby University. Dr. Wendell has returned after leave of absence and resumes the instruction given during his absence by Mr. Drisko. Mr. Charles T. Wentworth, Instructor in History, has also resigned and is now teaching at the B. M. C. Durfee High School in Fall River, Mass. Mr. Myron L. Fuller, Assistant in Geology, has been appointed Instructor. Mr. Francis H. Dike has succeeded Mr. Léon E. Bernard as Instructor in French.

The following Assistants have terminated their connection with the Institute:

Edward M. Bragg,	Frederick L. Edmands,
George M. Holman,	Elbridge C. Jacobs,
Areli H. Jacoby,	Carleton S. Koch,
Louis J. Seidensticker,	Percy G. Stiles,

Robert G. Valentine.

The following new assistants have been appointed:

Henry E. Andrews, A.B., in English.
Charles W. Berry, S.B., in Mechanical Engineering.
Arthur A. Blanchard, S.B., in Theoretical Chemistry.
Fred E. Busby, S.B., in Industrial Chemistry.
William D. Coolidge, S.B., Ph.D., in Physics.
Alvan L. Davis, S.B., in Mining Engineering.

Harrison W. Hayward, S.B., in Mechanical Engineering.
Walter H. James, S.B., in Mechanical Engineering.
Fred. L. H. Kimball, S.B., in Mining Engineering.
William S. Newell, S.B., in Mechanical Engineering.
George H. Priest, S.B., in Oil and Gas Analysis.
George H. Riker, S.B., in Mechanical Drawing.
Norman E. Seavey, S.B., in Physics.
Miles S. Sherrill, S.B., in Analytical Chemistry.
Frank R. Swift, S.B., in Mechanical Engineering.
Etheredge Walker, S.B., in Mining Engineering.
Charles-E. A. Winslow, S.B., in Biology.

William Skarstrom has been appointed Instructor in Gymnastics, in place of H. J. Boos, resigned.

Entrance Requirements.

Solid Geometry has now become an absolute entrance requirement without evidence that it occasions serious difficulty on the part of teachers or applicants.

The number of students passing more than our requirements in modern languages continues to increase, there being 33 applicants who passed Advanced German and 98 who passed Advanced French the present year, while 41 passed both Elementary French and Elementary German.

Scholarships.

The work of the Scholarship Committee of the Faculty has increased this year beyond previous experience. Your Executive Committee assigned for the present year $7,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 164, while 137 submitted applications for the 40 State scholarships. Sixty-seven of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 234. Of these 43 have received scholarships to the amount of full tuition, 129 others have received smaller

amounts, averaging somewhat more than $100 each. It may be added that, in accordance with the act of the Legislature authorizing division of State scholarships, 26 of the 40 were so divided, thus increasing the number of recipients to 66.

Graduate Scholarships.

The graduate scholars of the current year are Messrs. Lewis B. Abbott, of the class of 1899; W. T. Keough, of the class of 1888; and Clifford M. Swan, of the class of 1899. Mr. Abbott is a candidate for the Master's degree; Mr. Keough is continuing his special work in Naval Architecture; Mr. Swan is a candidate for the degree of Doctor of Philosophy.

Fellowships.

Mr. George K. Burgess, of the class of 1896, retains the Savage Fellowship, and is continuing his studies in Paris. The Swett Fellowship, held last year by Mr. Coolidge, of the class of 1895, has been awarded to Mr. Gorham Phillips Stevens, who took his Bachelor's degree in Architecture in 1898, his Master's degree in 1899. Mr. Stevens is now engaged in architectural study in Europe.

The following work has been done by the fellows of last year:

Mr. Herbert W. Chamberlain, of the class of '95, last year appointed a fellow, died on the 26th May, 1899, at Siena, Italy, while pursuing, together with his wife, also a graduate in Architecture, a series of investigations and measurements upon characteristic examples of Italian architecture. The Institute had already received many carefully measured drawings, showing work of great promise, and the deepest regret is felt at Mr. Chamberlain's untimely death.

It has been noted elsewhere that George V. Wendell and William D. Coolidge have completed their fellowship work, and have entered the instructing staff of the Institute.

Dr. Wendell was Assistant, 1892, and Instructor, 1893–96, with a very responsible position in charge of recitations of

the second-year class in physics. In 1896 he was granted the Savage fellowship, and leave of absence, took his Ph.D. degree at Leipsic in 1898, and remained a year longer studying at the University of Berlin. His work in Leipsic was principally in optics, and he presented a research on rotary dispersion for his thesis. At Berlin he investigated the conduction for heat of rarified gases, an important subject in connection with the kinetic theory of gases. A research was also undertaken upon the electric conductivity of bismuth in a magnetic field.

Dr. Coolidge studied Physics and Chemistry at the University of Leipsic, in 1897–99, and during the latter year he was appointed assistant to Professor Drude. He presented as his thesis research dielectric oscillations in wires, and gave an experimental lecture at the Dusseldorf meeting of German scientists on a new method for the demonstration of electrical oscillations in wires.

The Coöperative Society.

A large contribution to the scholarship fund has this year been made from the profits of work by this student society, and they recommend certain of their comrades for the grants of scholarships which are made by a committee of the Faculty. The work is in itself helpful, and consists in supervision of the sale of text-books, drawing materials, and other articles, made by tradesmen affiliated with the society, and the sale of second-hand books belonging to members. Stands for the sale of these articles have been placed for the convenience of our students in several of our buildings. The profits are derived from membership tickets, sales, and advertisements.

The establishment of rules and of forms of contracts has been the subject of much consideration among the student members, and they have been asked by the United States Director of the Department of Social Economy to send an account of their methods of doing business to the Paris Exposition.

New Courses of Instruction.

An optional course in Landscape Architecture has been planned to diverge from the architectural course in the second year, and Mr. Guy Lowell, who graduated from the Institute in 1894, and has recently received a diploma at the French government school of Fine Arts, has been appointed to lecture upon this subject, which he has made an object of special study while in Europe.

In addition to the programme elaborated by our own departments, engineers, landscape gardeners, and architects have been consulted, and our thanks are due for the very carefully considered projects of work which have been made for us. Each author has shown a tendency to multiply studies in his favorite branch, so that the only difficulty has been in reducing the number to a suitable course, of which a schedule will be issued later. A main feature of the new option will be a very thorough course in Horticulture at the Arnold Arboretum, which is under the direction of Mr. Charles S. Sargent. Horticultural and botanical studies in the laboratory and the field will extend through three years, and ample opportunities will be offered not only to learn the habits of trees, shrubs, and plants, but also to study landscape gardening effects in the park of the Arboretum, which is of easy access from our Institute. Excursions will also be made for the same purpose to suitable localities. The engineering practice required for grading, masonry, and other work will be taught, so that correct plans and estimates can be made. Architectural studies and skill in design and composition are most essential parts of the course.

The consultations referred to above give added proof that a course in Landscape Architecture, which has now become one of the professional demands of our country, can be best given in conjunction with a strong school of architecture and engineering, and we are fortunate in being able to establish a connection with the Arboretum, which Mr. Sargent's publications have made known throughout the world as a great horticultural station.

An option in Heating and Ventilation has been added to the three already existing in the Department of Mechanical Engineering. The technical requirements are now so distinctly marked that it has been found advantageous for a mechanical engineer, after he has mastered the earlier parts of the theory of his profession, to decide whether his studies of the fourth year shall turn towards marine engineering, locomotive construction, or mill engineering; and we believe that heating and ventilation has now stepped into a place of similar prominence, and that more extended instruction should be given. We are informed by persons interested in the school that professional situations are awaiting young men equipped in this special engineering branch; and our thanks are due to Mr. J. E. Powell, chief mechanical and electrical engineer of the Treasury Department, Washington, for carefully considered suggestions regarding studies.

Professor Woodbridge will give the new course of instruction in this option, in addition to the shorter course now given at the Institute, and will make the students acquainted with professional practice, by showing them work which he and others are engaged in, and by setting problems in designing plants.

Departmental Reports.

Mathematical Department. — The work of the department has progressed along the usual lines. In the arrangement of work for the present year some changes have attended the discontinuance of instruction in solid geometry, which is now an absolute requirement for admission. An increase in the number of students taking differential calculus has led to a corresponding increase in the number of sections into which the class is divided, from 12 to 14.

Mention was made in the last Report of the preparation of Room 20 in the Rogers Building as a Mathematical Library. The room is now fully furnished, and the members of the department are much gratified at having quarters conveniently and pleasantly situated, handsomely fitted up, and

well adapted in every way to the purposes intended. Ample space in the cases has been provided to allow for the expected growth in books and models during a number of years, while the plan is such that the cases can readily be extended whenever needed.

The Library has just received a most notable increase in the number and importance of its volumes through the generous gift by Professor Runkle of his entire collection of books in Mathematics and Astronomy. This collection consists of about 450 volumes, besides many pamphlets and monographs, and contains numerous rare and valuable treatises that are now difficult to obtain. It comprises also many of the early numbers of mathematical journals, and a very complete collection of text-books illustrating the progress and development of the teaching of elementary mathematics in this country during the past seventy years. In recognition of Professor Runkle's long and eminent service as a senior member of the mathematical department, and of his generous interest in the library, it has been named by the Executive Committee "The Runkle Library of Mathematics." By means also of the special appropriation last year and a needed increase in the annual appropriation, the library is now in excellent condition to meet the needs of our Faculty and students. The following periodicals are regularly received:

Acta mathematica, American Journal of Mathematics, Bulletin of the American Mathematical Society, Annals of Mathematics, Bulletin des sciences mathématiques, Journal für die reine und angewandte Mathematik, Journal de mathématiques elementaires, Journal de mathématiques pure et appliquées, Mathematische Annalen, Messenger of Mathematics, and Quarterly Journal of Mathematics Pure and Applied.

Courses I. and XI., Civil and Sanitary Engineering. — The new arrangement of the rooms of the department affords ample accommodation, and the work can now be carried on with greater efficiency than ever before. In particular, the collec-

tions of photographs, drawings, and samples of material are now rapidly increasing. During the past year the department has received the following gifts: One thousand three hundred and ten blue prints; eighteen framed photographs; seventy unframed photographs, among which is a set of twenty photographs of engineering work in Vienna, received from Prof. F. von Emperger, and an album of twenty-three large photographs from the Gütehoffnungshütte, in Germany; four hundred and forty-nine charts from the United States Coast and Geodetic Survey; and eight charts from the United States Geological Survey. A large number of samples of building materials have been received from various firms and individuals. Particular mention should also be made of a gift to the department from Mrs. E. H. Faucon, of Milton, Mass., in memory of her son, Gorham F. Faucon, of a large number of valuable engineering books and of one hundred and eighty-two sheets of foreign plans and maps of great interest. An impulse wheel, three feet in diameter, with fittings, has also been presented to the Institute by the American Impulse Wheel Company of New York, through the courtesy of Mr. A. V. Garratt, Engineer of the Lombard Water Wheel Governor Company. In addition to the persons who have thus contributed, the thanks of the Institute are due to President Tuttle, of the Boston & Maine Railroad; W. H. Barnes, General Manager of the Boston & Albany Railroad; and A. C. Kendall, General Passenger Agent of the New York, New Haven, & Hartford Railroad, for courtesies of various kinds. The department has also purchased a large number of new instruments for use in surveying and hydraulics, including four new plane tables, a new current meter, several barometers, and numerous smaller instruments. The equipment of the geodetic observatory has been increased by the addition of a dip circle and by two special switch-boards to be used in connection with longitude determinations. The collection of photographs of the department has also been increased by the purchase of over fifteen hundred new photographs and a large number of new slides.

The range of occupation open to graduates in this department is steadily increasing, and at the present moment the demands upon us for engineers show that a much larger number could find immediate employment. Even during the years of business depression, the department each year had more applications for men than it was able to supply, and during the past year the demand was greatly increased.

SUMMER SCHOOL OF THE CIVIL ENGINEERING DEPARTMENT. — The twelfth summer school was held at Cherryfield, Me., in June last, and was attended by twenty-five third-year students, the largest number that has ever attended any summer school of the department. The work was in charge of Professors Burton, Porter, Robbins, and Barton, and Instructors Sweet and Hosmer, with the assistance of Messrs. Parker and Clapp of the class of 1899.

The party left Boston June 8th and returned July 8th. Three weeks were spent at Cherryfield, Me., devoted to work in geodesy and hydraulic measurements. A base line was measured and a system of triangulation developed which was used as a basis for a plane table survey on a scale of 1 to 5,000, with contours at intervals of ten feet. A square mile of territory was mapped in this way, including the five dams on the Naraguagus river. The discharge of the river was determined by the use of floats and current meters, and the meters were rated in still water. The elevation of the crests of the different dams above mean high water was measured, thus enabling the gross horse-power at this point in the river to be computed. Meteorological and tidal observations were taken at Milbridge, a short distance from Cherryfield on the coast. A plane table survey was made of Milbridge harbor and about a hundred soundings taken, locating the channel. A visit was made to the old Epping base of the United States Coast Survey, which was measured in 1857.

At the close of three weeks of surveying, a geological excursion was taken under the direction of Professor Barton. The party spent a day at the Joggins Coal Mine in Nova

Scotia, visited iron and gold mines near Halifax, and after a very interesting and instructive trip to the points of geological interest arrived in Boston July 8th.

An appropriation has been made to send Professor Burton and a small party to Georgia in the middle of May to make time observations in connection with the total solar eclipse of May 28th. The equipment of the geodetic observatory will be used in these observations, and in addition an arrangement has been made for the loan of two 5-inch Clark telescopes with mountings.

Course II., Mechanical Engineering. — A planer has been added to the equipment of the engineering laboratories and this, together with the engine lathe and speed lathe which we have already, will enable us to have some of our machine tool work done at the Institute instead of outside.

A three-stage air compressor has been ordered, having a capacity of 100 cubic feet of free air per minute, which it can compress to a pressure of 2,500 pounds per square inch. In consequence, however, of the great activity in all kinds of business it has not yet been delivered.

Attention is called to the facilities offered by the following firms to our students doing Thesis work:

Through the kindness of Mr. Hayden, the Vice-President of the Boston & Albany Railroad, Messrs. B. S. Hinckley and H. A. B. Campbell were enabled to make for their thesis a series of economy tests of a two-cylinder compound locomotive recently built for the road. The locomotive was a twelve-wheel engine carrying heavy freight which exerted, on an average, about 600 horse-power, and at times more than 1,000 horse-power. The tests involved the determination of the horse-power developed, and also of the coal and water consumption in each of six runs from Albany to Springfield.

By the courtesy of Col. E. D. Meier Mr. H. L. Morse was enabled to make a series of tests of a Diesel motor which was on exhibition at the fair of the Massachusetts Charitable Mechanic Association.

The publication of the results of tests in the "Technology Quarterly" has been continued; No. XI. was published in Vol. XII., No. 3, of the Quarterly in September, 1899. The following publications have been made by members of the department, viz.:

A new and revised edition of the Notes on Dynamometers, Planimeters, Governors, and Fly Wheels, by Professor Lanza.

A new edition of the Notes "Illustrations of Engines and Machines," by Professor Peabody.

Two articles on "Testing" in "Machinery," by Professor Miller.

APPLIED MECHANICS. — The range of tests made in the laboratory of Applied Mechanics during the past school year involved:

Tension of high carbon steels.
Crushing strength of brick.
Tests of iron and steel in tension.
Tests of aluminum.
Crushing of 2-inch cubes of cement.
Transverse tests of wrought-iron bars.
Tests of aluminum wire.
Tests of steel wire.
Torsion of $1\frac{1}{16}$-inch diameter cold rolled steel shafting.
Torsion of aluminum rods and wire.
Torsion of steel rods and wire.
Tests on strength of rope.
Tests to find efficiency of knots for holding rope.
Transverse tests of spruce and yellow-pine beams.
Testing cement in tension.
Mixing cement for testing.

The space gained in the laboratory has also enabled us again to pursue investigations upon the effect of applying the load to timber beams for a long time.

SHOPWORK. — The total number of students receiving instruction is 238. Many of these take more than one course, and they are divided among the different classes as follows:

Carpentry and Wood Turning	104
Forging	95
Chipping and Filing	72
Machine Tool Work	42
Metal Turning	47
Pipe Fitting	4
	364
Students taking work in two or more classes and counted more than once	126
	238

The total number in 1897–98 was 210; in 1898–99 it was 231.

The Machine Shop now accommodates 23 students, and the class now taking the machine tool work in two sections numbers 42. Had there been no summer course it would have been impossible to accommodate all applicants this year. Should the number of students taking the work continue to increase it is probable that arrangements will need to be made for a greater number of sections or for increased equipment in the crowded departments.

The improvements made last year have been of great advantage. The instruction room for the machine-shop has proved so convenient that similar rooms are recommended for the wood-working and forging departments. The equipment remains essentially the same as for last year. It is hoped, however, to add a turret lathe to the machine shop equipment before the end of the school year.

Course III. Mining Engineering and Metallurgy. — The whole lower floor of the Rogers Building is now used by this department, and the work is conducted to great advantage. The lecture charts and specimens are within easy distance of the lecture-room. The lecture-room, library, laboratory, and offices can all be quickly reached from each other. As a result of these new facilities the thirty-one members of the present large fourth-year class, in the mining and metallurgical laboratories, are carried through their studies with relatively greater ease than the smaller previous classes, and are receiving a better course of instruction. The class is

divided into three sections. Professors Richards, Hofman, and Lodge take charge of a section each for a week in rotation. By this arrangement every student in the class has either taken a part or performed the whole work in eighteen different processes or experiments, distributed over ore-dressing, roasting, smelting, amalgamating, and leaching.

The arranging and labelling of the collections of ores and metallurgical products has been interrupted by the great demands of the laboratory. This work will be continued as time is found for it.

The ore-dressing laboratory has received the following additions to its plant: an Embrey belt vanner, which can be used either for the ordinary vanner work or for the special work of concentrating extremely fine slimes; a Wilfley table, which will introduce the student to this new and most useful class of concentrating tables. The assaying room has received large additions to its furnace plant, and now has twenty crucible furnaces, thirteen muffle furnaces, and a new oil burner muffle furnace.

Professor Richards' book on Ore Dressing is now in the hands of the printers.

A new edition of Professor Hofman's book on Lead has been issued.

Professor Lodge's new lithographic notes on Assaying are now ready.

THE SUMMER SCHOOL OF METALLURGY was this year held in New Jersey and Pennsylvania. Visits were made to smelting works and mines. The former were given the most prominence; the party numbered ten, including Professors Richards and Hofman, together with eight members of the second, third, and fourth year classes in mining engineering. At Bergen Point, N.J., the smelting and refining of copper was studied at the works of the Orford Copper Company. The blast furnaces, the open hearth department, the shops for making guns and armor plate of the Bethlehem Iron Works were inspected at Bethlehem, Pa., and the manufacture of spelter and zinc-white was studied in the

works of the New Jersey Zinc Company. At and near Pittsburgh, Pa., the party made studies of blast furnaces in Shoenberger & Company's works and in the great Duquesne plant of the Carnegie Steel Company, Limited; of Bessemer steel plants at Jones and Laughlin's and at the Edgar Thompson works; of open hearth steel plants at Shoenberger's and at the Homestead Works; of the manufacture of iron tubes at the National Tube Works; of fire bricks at the works of Harbison and Walker; of puddling at the Sable Iron Company's works; of wire rolling and drawing at the American Steel and Wire Company's works; and of crucible cast steel at the Crescent Steel Company's works. The party visited the coal mine of the Essen Coal Company, where electric machinery has been largely introduced.

The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest taken in the students, to whom the freedom of the works in each case was cordially granted.

Course IV., Architecture. — Since the last report no changes have been made in the arrangement of studies of the regular course.

The option in Architectural Engineering introduced last year is now well under way, and will present an excellent class for graduation next spring.

The recently created option in Landscape Architecture offers opportunity for study in new directions, and is a distinct step in advance. The course of study is the result of the fullest coöperation between the Institute and practising landscape architects of the highest rank in their profession. The value of this assistance will be better understood when it is known that no precedent exists on which to base such a course, and that the prescribed studies represent the result of personal experience during years of active practice. The schedule of studies in this option has been under consideration for some time and now approaches complete form. Next term the department will be prepared to receive students in the second-year work of this option.

Although no change has taken place in the titles of the studies of the regular course, considerable internal change has been developed in the professional courses. Among these improvements may be mentioned the free use of lantern-slide illustrations for all lectures, the addition of valuable details to the courses in history of architecture and construction, the frequent use of models instead of casts for freehand drawing, and the better draughtsmanship shown by the classes in design. It has, however, been felt for some time that closer correlation is needed in the professional work of the different years, and that the more complete study of the later periods of the history of architecture should be introduced as soon as possible.

The greatest addition in equipment is due to the purchase last summer of sixty-five casts of Roman architecture, which offer excellent opportunity for the study of good antique and renaissance detail. Part of these casts are now temporarily placed in the studio and library, awaiting the arrival of the larger fragments that are to be specially made for the department. Among the large casts are the full-size section of the cornice of the temple of Castor and Pollux in the Roman forum, the order from Trajan's arch at Beneventum, and a portion of Sansovino's monument to Cardinal Girolamo Basso della Rovere in the Church of Santa Maria del Popolo at Rome.

The Library is improved each year, and although few expensive books have been added lately, new photographs to the number of 2,900 have been added and are now being put in circulation, 3,000 old photographs have been remounted on cards of uniform size, 400 lantern slides have been added to our previous large collection, and a new and enlarged card catalogue provided for the use of students and instructors.

In the Exhibition Room, in addition to the continuous display of drawings, large numbers of photographs and diagrams of historical importance are arranged each week to illustrate the regular lectures and to assist students to a working knowledge of architectural precedent.

At the request of the department the visiting committee from the Boston Society of Architects has been changed from nine to three members, the committee consisting this year of Mr. Robert S. Peabody, Mr. R. Clipston Sturgis, and Mr. Philip Hale. Because of Mr. C. Howard Walker's absence in Europe, Mr. Walter H. Kilham is giving the lectures of the course in history of ornament. Mr. Harry W. Gardner, Instructor on leave of absence, and Mr. George P. Stevens, the holder of the Swett fellowship, report progress of studies in the north of Italy, and that several measured drawings have been made as "envois" in Bologna and Florence.

The department mentions with deep regret the death at Siena, Italy, last June, of Mr. H. W. Chamberlain, one of our most conscientious and loyal graduates. Mr. Chamberlain was working under the direction of the department, and had sent home one set of drawings made in Rome. His remaining sketches and measured drawings are now being drawn in formal manner by Mrs. Chamberlain, and will be given to the Institute.

A large number of our graduates desire to continue their studies abroad and a year's architectural study and travel in Europe forms an excellent continuation of the regular course and the benefit, direct and indirect, is great when the studies are properly directed under scholarship supervision. The Perkins graduate scholarship is devoted to this purpose and a part of the Austin fund is available, but other foundations would render great aid to the Architectural department.

The Rotch prizes given annually to students in the department were this year awarded to Mr. L. B. Abbott and Mr. J. F. Clapp.

SUMMER SCHOOL OF ARCHITECTURE. — The Summer School of Architecture this year had a very profitable European tour. Starting from Genoa, two weeks were spent in Milan, Brescia, Verona, and cities of north Italy, including a five days' visit in Venice. After a quick return from Venice

to Genoa the party began its bicycle ride along the western Riviera to Paris through Mentone, Monaco, Nice, a section of the Maritime Alps, Frejus, and Toulon to Marseilles. Then turning north, two weeks were spent in the Rhone Valley visiting Aix, Arles, Nîmes, Avignon, and many architecturally interesting towns, finally leaving the valley at Viviers for the climb over the Cevennes mountains to the higher levels of the Puy de Dôme region, — a very interesting trip through sections seldom visited by tourists. Passing through Riom, Vézelay, Sens, Moulin, Nevers, Bourges, Troyes, and Fontainbleau, the school reached Paris in good condition on August 10th.

Much hard riding was encountered in the mountains of the Riviera and the Cevennes and in pushing against the strong head winds in the Rhone Valley, but these hard days were offset by many delightful rides.

Measured drawings were made at Venice and Arles, and sketches were made in most of the towns visited. Over 700 negatives were taken with hand cameras of important details, interesting buildings, and local scenes. The successful pictures will be added to our library collections of photographs and lantern slides, filling up many vacant spaces. The school passed through very rich architectural regions, and profited greatly by observation and local study. It is only to be regretted that more students could not take advantage of the opportunity.

Courses V. and X., Chemistry and Chemical Engineering. — No important changes have been made in these departments, and the rearrangement of rooms made in the summer of 1898 has proved as satisfactory as was predicted last year. Owing to the increased size of the classes, the corps of chemical instructors has been increased by the appointment of two new Assistants in Analytical Chemistry and Theoretical Chemistry respectively.

A ventilating fan, driven by an electric motor, has been placed on the roof of the Walker Building and connected with the flues leading from the hoods in the laboratories of organic

chemistry on the fourth floor, and of analytical chemistry on the third floor. By means of this fan a much larger volume of air is drawn into these laboratories than formerly, and as this is made to pass out through the hoods, a marked improvement in temperature and ventilation of the room and in the working efficiency of the hoods has been the result.

The first-year laboratory has been renovated and improved by wholly renewing the drainage system, putting new tops upon the laboratory benches, adding 80 permanent lockers in place of the same number of temporary lockers, and substituting open top gutters for sinks. This includes the renewal of the platform and all the piping.

A short course in shopwork has been arranged for Course V. designed to familiarize the student with the common tools to enable him to construct or repair the usual chemical apparatus.

It is pleasant to note that there is an increasing appreciation of the value of the William Ripley Nichols Chemical Library, as shown by the number of persons who consult it, and their often enthusiastic commendations of its completeness. The additions of the important chemical publications of the year have been made, as usual.

ORGANIC CHEMISTRY. — Twenty-nine students are working in the laboratories of organic chemistry.

A room has been equipped as a tool-room for the use of the Chemical Department, and is fitted with a power lathe run by an electric motor, and with an ample supply of tools for the work required to be done. Another room has been equipped as a "dark-room" for photographic work, and is proving itself most valuable.

The room adjoining the Kidder Chemical Lecture-room, formerly used as a store-room, has been partitioned off so that one-third serves for the preparation of experimental lectures, and the remainder, a space of 16 × 30 feet, is now used as a special research laboratory and is provided with electrolytic apparatus beside the usual laboratory fittings. It is now occupied by one of the Instructors in Organic Chemistry

and by two graduate students, one working on the atomic weight of tellurium and the other on a special organic investigation.

ANALYTICAL CHEMISTRY. — The total number of students taking analytical chemistry is 145, of whom 77 are taking qualitative and 68 quantitative analysis at the present time. This is a slight increase over the total number of last year, and is nearly sufficient to fill the two laboratories of analytical chemistry.

It is interesting to note that the number of students who present evidence of having had sufficient training in chemistry in the secondary schools to admit of excuse from the work in general chemistry of our first year is gradually increasing. Twelve such students have been admitted to the classes in analytical chemistry this year, and are carrying on the work of the course successfully. Such of these students as are anticipating the chemical courses of the later years will, in many instances, desire to take more extended courses in inorganic chemistry in the time thus gained, and questions relating to their instruction and accommodation will probably soon present themselves for consideration.

No changes, except in details, have been made in the methods of instruction in analytical chemistry during the past year. The services of an additional Assistant in the instruction of the advanced students became a necessity as a result of the large number in these classes.

A valuable microscope, especially equipped for use in the examination of metals, has been added to our equipment, and Dr. Fay has devoted much attention to metallographic work during the past year, including the direction of thesis work of this character.

The Laboratory of Sanitary Chemistry has been fitted with electric heaters for the Soxholet extraction apparatus, thus avoiding the danger from fire in the use of ether and gasolene. There has also been installed a specially designed still for the supply of doubly distilled water for the use of the Chemical and Physical Departments in conductivity experi-

ments and water analysis. The Notes in Sanitary Chemistry are to be published in the spring under the title "Air, Water, and Food."

The laboratory for Oil and Gas Analysis has received a fine collection of essential oils from Fritzsche Brothers and Dodge & Olcott, of New York.

For work in sugar analysis a Scheibler saccharimeter has been purchased.

TEXTILE COLORING. — The new Textile Coloring Laboratory is found to be in every way a great improvement over the old one. The lighting of this room with north skylights, thus avoiding direct sunlight and reflected light from colored objects, enables the student to match colors for dyeing to shade with greater ease and precision than could be done in the old laboratory. Eleven students took the textile coloring option last year, which includes about thirty lectures and sixty hours of laboratory work.

During the term visits were made by the class to the Robert Bleakie Co., Woolen Mill, Hyde Park, Mass., Mr. C. F. Allen, Treasurer, and to the Middlesex Dye, Bleach, and Print Works, Somerville, Mass., Mr. George L. Gilmore, Superintendent, to whom thanks are due for courtesies.

INDUSTRIAL CHEMISTRY. — Thirty-eight students worked in the new laboratory last year. Its superior ventilation was fully demonstrated during the year. A small ore crusher has been added to the equipment of the laboratory.

The class attending lectures upon Industrial Chemistry numbered forty-three, and the instruction comprised sixty-seven lectures and nine written and oral recitations. The usual number of lectures were given by gentlemen not connected with the Institute, and excursions made to the following works: Curtis Davis Soap Company, Cambridgeport, Mr. E. D. Mellen, Treasurer, Mr. J. W. Loveland, Manager; Farwell Bleachery, Lawrence, Mr. Kirke W. Moses, Agent; International Paper Company, Russell Mills, Lawrence, Mr. Hugh J. Chisholm, President, Mr. G. F. Russell, Manager; Lewis' Wool Scouring Mill, Lawrence, Mr. H. Bradford Lewis,

Superintendent; Malden Gas Works, Malden, Mr. Thomas H. Hintze, Superintendent; Merrimac Chemical Works, South Wilmington, Mr. A. P. Howard, Superintendent, Mr. H. Howard, Assistant Superintendent; Union Glass Company, Somerville, Mr. J. de Cordova, President. The Institute is under obligations to the above-named gentlemen, and to Mr. D. J. Flanders, General Passenger Agent of the Boston & Maine Railroad, for courtesies extended to our students in connection with these excursions.

The new lecture-room in the Henry L. Pierce Building has proved very satisfactory as to lighting and acoustics. It is arranged for the exhibition of lantern slides, but the darkened room causes difficulty in taking notes; consequently one hundred and twenty-five India-ink drawings and about seventy charcoal sketches have been prepared by Dr. Thorp, all sufficiently large to serve as wall charts, and their use has been found much more satisfactory than lantern slides.

A fund generously provided by Mr. Samuel Cabot has enabled Dr. Thorp to spend the summer in visiting the principal chemical manufactories of England, France, and Germany.

BOOKS PUBLISHED. — Thorp, F. H.: Outlines of Industrial Chemistry (second revised edition).

Richards, Ellen H.: The Cost of Living as Modified by Sanitary Science.

Gill. A. H.: Gas and Fuel Analysis for Engineers (second revised edition).

Gill, A. H. (compiler): A Register of Publications of the Institute (supplement to the third edition).

ARTICLES PUBLISHED. — A. A. Noyes: 1. Die Beziehung zwischen osmotischer Arbeit und osmotischem Druck.

2. Die thermodynamischen Ausdrücke für die Lösungs- und die Dissociationswärme von Elektrolyten.

Richards, E. H.: The Relation of the Higher Educational Institutions to Commercial and Expert Work.

G. W. Rolfe and George Defren: Manufacture and Use of Brewing Sugars.

S. P. Mulliken and H. Scudder: A Simple Color Reaction for Methyl Alcohol.

Whitney, W. R.: The Nature of the Change from Violet to Green in Solutions of Chromium Salts.

Woodman, A. G.: On the Determination of Added Water in Milk.

Courses VI. and VIII., Electrical Engineering and Physics. — In these courses there has been continued development in various directions. The lectures in General Physics in the second year have been materially aided by the addition of much new apparatus for demonstration, especially in electricity and light. A serious difficulty in connection with these lectures is that while there has been a vast increase in the number of topics that must be considered at length even in a course for beginners, the allotted number of exercises is no greater than it was twenty years ago. Some relief is afforded by the fact that about eighty per cent. of the students have studied physics to some extent before entering the Institute, which was not formerly the case; so that a more philosophical treatment of the subject is possible, while the recitations also allow of the omission of certain of the less difficult topics from the lectures.

The last year closed the connection with the department of Mr. Wm. J. Drisko, who has recently been appointed to the chair of Physics at Colby University. He resigned his position of Instructor in Physics after having taken charge of the recitations for the past three years. Mr. Drisko has been singularly successful in this onerous work, and has won the respect alike of his pupils and colleagues. During the present year the recitations in physics are again in charge of Dr. Wendell, who has returned from a three years' course of study in Leipsic and Berlin.

The Laboratory of General Physics has acquired several valuable pieces of apparatus during the past year, among which may be mentioned a Zeiss comparator, a Zeiss spherometer of novel construction, a Michelson refractometer, and a Rowland concave grating with mounting for photographing

the spectrum. A new photometer room has been fitted up for work with the spectrophotometer and Weber photometer.

The introduction of physical laboratory work into the Course in Chemistry in the second year, with lectures at the same time on physical measurements as previously arranged for Courses VI. and VIII., has proved of decided advantage to the students, and a like arrangement for all the engineering courses is very much to be desired.

The enlargement of the Physico-Chemical Laboratory mentioned in last year's report has greatly facilitated the instruction given therein. A large electrically heated and regulated thermostat six feet by three feet has been devised and added to the equipment of the laboratory, by which a great saving of time is effected for the students by allowing various lengthy operations to be carried on continuously during the night.

The work in this laboratory suffers from the necessity of having to accommodate classes and students working on theses at the same time. Special rooms for investigation for students taking physical theses are very greatly needed.

In the Laboratory of Electrical Measurements a number of new experiments have been introduced and the purchase of additional apparatus has allowed of much improvement in others. An important addition is that of two small specially constructed dynamos of high voltage for testing and calibration of instruments, and also a set of standard resistances of large carrying capacity standardized at the German *Reichsanstalt*. These constitute a portion of a complete set of calibration apparatus now being designed and constructed in the Rogers Laboratory, which when completed will allow of exact verification of electrical measuring instruments for both direct and alternating currents throughout the widest range. Beside these there have been added several Wheatstone bridges, a Rowland electrodynamometer and an apparatus designed in the laboratory for photographic study of the form of alternating current waves. The amount of instruction called for in this laboratory has been greatly increased by the

recent introduction of a large amount of advanced work for the students in the chemical courses.

In the Laboratory of Electrical Engineering much new apparatus has been added, this being largely made within the department. Worthy of special mention are a set of model lecture apparatus for illustrating the behavior of polyphase motors and compensators, and a set of transformers designed to show the various possible combinations and connections, and to exhibit their effect. Also worthy of notice are a new apparatus for the stroboscopic study of the alternating current arc, and a collection of arc-lamps of various types for testing. There is at present in process of construction in the laboratory an assemblage of apparatus for familiarizing the students with the various special methods of testing polyphase alternating current machinery. This comprehends eight or ten instruments and transformers built expressly for the purpose, together with a switch-board of peculiar construction.

During the last year the lack of sufficient engine power in the dynamo room has been seriously felt The rapid and excessive increase in the call for electricity for purposes of general illumination has at times exceeded the available power, so that serious and on occasions even dangerous overloading has occurred. A partial remedy has been provided by an enlargement of the supply mains from the Edison system. There is abundant dynamo capacity for all present needs, but a new engine will be necessary to secure the proper illumination of the Rogers and Walker Buildings.

The increased space which was allotted last year to the Laboratory of Heat Measurements has allowed of much improvement in the instruction; indeed, without such enlargement it would have been physically impossible to give the instruction called for. Notwithstanding the advanced character of the work it is at present taken by about seventy-five students, miners, chemists, and physicists. The equipment of the laboratory has been greatly increased and is now

excellent, including much apparatus of original design and construction.

Two new optional courses of lectures have been established in the department, not required, but open to students approved by the Faculty. The first of these, by Mr. Louis Derr, is devoted to Calculating and Computing Machines, their theory and use, and is intended to lead the students to a more extended use of such aids to computation. A second course is upon the Applications of Polarized Light in Physics and Chemistry, by Dr. George V. Wendell. This will contain a full discussion of the theory and construction of different forms of polarimeters, saccharimeters, and other similar apparatus, and of their various applications.

At the present time the department is contemplating the presentation to the Faculty of a modification of the course in Physics — Course VIII., — which will give to students desiring it a better preparation than is at present available either at the Institute or elsewhere for entering upon the practical applications of electro-chemistry. Such a preparation calls for a larger amount of pure and applied chemistry than is properly given in a course in Electrical Engineering, while certain branches that are important in the latter course are not especially needed.

The department is still greatly cramped for room, a want which is well understood by the Corporation, and upon which I need not enlarge.

Books Published.

H. M. Goodwin: The Fundamental Laws of Electrolysis (Harper's Science Series).

L. Derr: Notes on Dynamo Design.

L. Derr: Notes on Methods of Telegraphy.

Articles Published.

S. H. Woodbridge: Congressional Report on Ventilation of House of Representatives, Washington.

S. H. Woodbridge: Report to Public Health Association on Car Sanitation.

S. H. Woodbridge: Car Sanitation, Paper read to New England Railroad Association.

S. H. Woodbridge: On the Ventilation of Audience Halls. Series of papers now issuing.

H. M. Goodwin and G. K. Burgess: The Osmotic Pressure of Certain Ether Solutions and its Relation to Van't Hoff's Law.

H. E. Clifford and J. S. Smyser: The Acetylene Standard of Light.

C. L. Norton: On the Rapid Measurement of the Tensile Strength of Cotton Fibres.

R. R. Lawrence: On an Automatic Mercury Pump.

H. W. Smith: On a Method of Measuring the Frequency of Alternating Currents.

Course VII., Biology. — The relief felt by removal to comfortable and spacious quarters in the new Henry L. Pierce Building has in this department been very great. The year's work was somewhat broken by the unavoidable delays in completion of the several laboratories, but this was more than made good by the greater convenience, during the last half-year, and especially at the beginning of the present year. Experience has proved that the general arrangement and equipment of the biological laboratories is in every case but one entirely satisfactory. Professor Sedgwick states that "the lighting and coloring are admirable; the relative absence of dust and noise is most welcome; the construction and furnishings are substantial and suitable." The bacteriological laboratory alone has proved to be unsatisfactory. Owing to the increasing size of the classes and the number of special workers in this subject and in sanitary and industrial biology, all carried on in the same room, this laboratory is already crowded. It is hoped that as soon as possible a more spacious room, or set of rooms, may be provided for this work.

The growing importance of practical laboratory work upon the theories and the arts of the purification of sewage and

water by natural and artificial processes, not only for biologists but also for chemists and engineers, has led Professor Sedgwick to urge the immediate construction of a special sanitary laboratory on the site of the present bicycle shed, in the court-yard of the Trinity-place buildings. He advises that such a laboratory be modelled on a small scale somewhat after that maintained for the last twelve years by the State Board of Health at Lawrence under the direction of a distinguished member of our corporation, Mr. Hiram F. Mills. In a laboratory of this kind those of our students who desired to do so might become practically familiar, by actual experiments, with the principles and processes which the Lawrence Experiment Station has worked out for the benefit of engineers and sanitarians; and if such a laboratory should be built it might well be made two stories high, the lower — like the Experiment Station in Lawrence — largely underground, the upper well lighted and suitable for classes in bacteriology and sanitary biology, including opportunities for some chemical work upon sewage and water.

The usual work of the department on the sanitary side has been continued by Professor Sedgwick, and an important piece of research has been completed under his direction by Mr. C.-E. A. Winslow, a graduate in Biology in 1898, who made this work the basis of his thesis for the degree of Master of Science in June, 1899. The investigation is entitled "Experimental and Statistical Studies on the Influence of Cold on the Bacillus of Typhoid Fever and its Distribution; with special reference to Ice Supply and the Public Health."

The course in Industrial Biology, comprising the practical application of bacterial and other microörganisms of fermentation to various technical and manufacturing processes, increases steadily in scope and importance. Its object is two-fold: first, to teach the application to the industries of useful organisms in their most important rôles; and second, to give some knowledge of organisms which may cause trouble in industrial processes, and to provide methods for their control or destruction. The theory of fermentation

is dwelt upon in detail, especially in the light of recent advances in our knowledge of the chemistry of enzymes. This course affords a common meeting ground for the practical biologist and the technical chemist. The students examine and study the action of the microörganisms in question, and, on a small scale, carry on some of the processes as these are used commercially. The relation of bacteria to sundry transformations in Nature which have a direct industrial or economic bearing — such as the fixation of nitrogen, nitrification, and oxidation — is also considered. The work on the improvement of processes of food-preservation, begun three years ago by Mr. S. C. Prescott of this department and Mr. Wm. Lyman Underwood, has been continued with valuable results. These were in part embodied in a paper presented at the joint meeting of the Atlantic States and Western Packers Associations at Detroit, in February last, the largest meeting of men engaged in the food-preserving industries ever held in this country. The work of Messrs. Prescott and Underwood is regarded as of so great value to these manufacturers that for the third year in succession Messrs. Prescott and Underwood have been asked to give some of the results of their investigations before these annual meetings.

While much of the work of this department is now directed towards the applications of biology to sanitary and industrial processes and their improvement, the fundamental basis of these and similar applications in its more purely scientific aspects is not neglected. An important part of the work in physiology continues to be directed toward the proper understanding of the problems of personal hygiene, and with each year the efficiency of this portion of our work is increased. There is a field for physiology as well as for bacteriology outside the very important one which each fills in the medical school. Year by year the attention given to practical problems of hygiene is increasing, and the solution of these problems must come not merely from physicians, but from physiologists as well. This is notably the case, for ex-

ample, with the important matter of school hygiene, which must take account of such physiological questions as physical training, fatigue, heating, lighting, ventilation, and the like, questions which can be solved only with the coöperation of those who are connected with school work and who have at the same time had proper training in applying scientific principles to the solution of the questions in hand. Professor Hough continues his studies on the physiology of muscular exercise, and together with Miss Ballantyne, a graduate of this department in 1899, has made investigations upon the effects of changes in external temperature upon the circulation of the blood in the skin. A preliminary report of their results has been published.

The only changes of importance in the staff of this department are the resignation of Dr. George M. Holman, Assistant, after two years of faithful service, and in the appointment in his place of Mr. C.-E. A. Winslow.

Course IX., General Studies. — In the work of this department there has been but little change during the past year. A new option is being given by Professor Sumner on Politics of Eastern Asia. Particular attention is given to recent commercial and trade developments. A graduate of this course, class of 1899, Amasa A. Holden, was awarded the first prize of $150 by the American Protective Tariff League for an essay on "The American Merchant Marine: its Restoration by Means of Discriminating Duties." During the early part of the year Professor Dewey was a member of a committee of the American Economic Association which made a report on the Federal Census, with a view of improving the methods of this administrative work of the United States government. He has also edited General Walker's miscellaneous writings on political economy in two volumes, entitled "Discussions in Statistics and Economics." Professor Ripley has also brought out in final form his essays on anthropology in a volume entitled "The Races of Europe." This is accompanied by a supplementary volume entitled "A Selected Bibliography of the Anthropology

and Ethnology of Europe," published by the Trustees of the Boston Public Library. The latter volume offers an interesting example of the co-operation of expert service with an important branch of the municipal government of Boston. Especial mention should be made this year of the commendable work of the Walker Club, an organization of students of the Course in General Studies, in the successful bringing out of a play which netted over $600 in aid of the Walker Memorial Gymnasium Fund. This play was managed entirely by students, and, although given once outside of Boston, as far as observed did not interfere with the regular school work.

The advance in English work, which has during recent years shown itself in secondary schools, enables the instructors in the English Department to appeal with more and more confidence to the intelligent interest of students. Each year there are more men from various courses who wish to enter the classes in advanced composition and literature, with a wide recognition of the value of such work to students of technical branches.

For some years the department has given to fourth-year students in mining engineering a course known as "Memoirs." It consists of a thorough revision of the English of abstracts made from technical articles in French and German magazines. The course thus has the threefold purpose of putting the student in touch with the work of foreign experts in his own profession, of keeping his knowledge of modern languages in working condition, and of giving him regular practice in the accurate use of English in connection with his special line of work. A similar course is to be given to first-year students in architecture. They will be required to read in French selections from the work of the best writers on architectural subjects, and to write essays on topics suggested by these articles. This written work will be criticised for English. This extension of the work of the department is gratifying, because it is by thus working in conjunction

with other departments that English composition may be most successfully taught in a scientific school.

In the October number of the "Technology Review" was published a paper by Mr. R. G. Valentine, recently an instructor at the Institute, giving an account of the work of the department in English composition, and the original methods which have, with good success, been devised and put into practice.

Course XII., Geology. — One year ago the working force of the Department of Geology was busily engaged in getting the specimens and the appliances for teaching into places where they may be readily obtained for use. Since that time good progress has been made toward a systematic arrangement of the collections so as to make them most serviceable in the work of teaching. Professor Crosby has so rearranged the petrologic and lithologic collections and a considerable portion of the mineralogical collections in over four hundred wooden trays that they are constantly ready to be placed before classes and thereby furnish each member a distinct series for individual study. Also a considerable amount of work has been accomplished in the numbering and labelling of the specimens of minerals, and these may now be freely used without danger of losing a record of their locality or other facts concerning them, and much has been done in the classification of the fossils, and progress has been made in the identification, numbering, labelling, and cataloguing the specimens.

The books of the Geological Library have been numbered and classified, but work remains to be done to complete the cataloguing.

The Geological Department, through two of its representatives, has had an opportunity of coöperating with the United States Commissioners to the Paris Exposition and the Massachusetts Board of Paris Exposition Managers in gathering collections of minerals and of building stones of the United States for the exhibit which the Government is to make at Paris. Professor Crosby, as one of the mineralogists to the

Commission, has collected over 400 minerals of the classes of carbonates and phosphates, making a collection which of its kind is perhaps unsurpassed by any in the country. The total cost of nearly $800 was furnished through the kindness of the Massachusetts Board of Paris Exposition Managers. Mr. Fuller, Instructor in Geology, acting as Special Agent to the United States Commission, has brought together a series of more than 300 samples of the more common and important building and ornamental stones of this country. The collection includes over a hundred polished slabs of marble, onyx, and serpentine, seventy-five dressed and polished samples of granite, and a large number of samples of representative sandstones, limestones, and slates.

At the close of the Paris Exposition these collections, with an aggregate value of more than $1,500, are to be returned to the Institute and will be incorporated with our other collections. The minerals are of unusually fine quality and will make a very important addition to the value and attractiveness of the collections of the department. The addition of the series of building stones to those we already have will make the Institute the possessor of an exceptionally valuable collection and one well adapted to giving instruction in the course in building stones.

Course XIII., Naval Architecture. — The arrangement of the work of the department has been much favored by the quarters assigned to it at the beginning of the year. A large increase in numbers has made it necessary to add to the space in the drawing-room for the third and fourth years, for which purpose a lecture-room adjoining was taken. To provide for the numbers that may be expected another year, Professor Peabody requests that the entire third floor of Engineering Building B may be cleared of partitions and made into a drawing-room for the third and fourth year classes of the department. A room with glazed walls in one corner of the proposed drawing-room can be made to provide for drawing cases, instruments, and other property of the department. At present the space is divided into three rooms,

one being used as a model-room and store-room, and the other two as drawing-rooms. It may be noted that the fourth-year class now numbers thirteen, the third-year class twenty-two, and the second-year class about twenty. Accession from other colleges is likely to give twenty or more in the third-year class next year.

Progressive speed trials were made by the department on the U. S. S. "Manning," with the consent of the Secretary of the Treasury, and under the authority of Captain C. F. Shoemaker, Chief of Division of the Revenue Cutter Service. These trials were made on June 9, 1899, over the measured mile maintained by the Bath Iron Works, at Southport, Me. The party which made these trials included Professor Peabody, Assistants Clark and Riley, and five graduates from the department. A report of the trials has been prepared for the annual meeting of the Society of Naval Architects and Marine Engineers, to occur the 16th inst.

The department has now graduated five classes, numbering thirty-five in all. Of these, three are in business, one is Instructor in Naval Architecture at the Institute, three others are Assistants or Instructors at the Institute, and twenty-eight are engaged in the practice of their profession.

SUMMER COURSES.

The attendence at summer courses this year was as follows:

I. Mechanical Drawing and Descriptive Geometry. 30. (Prof. Faunce.)

II. Mathematics: Analytic Geometry. 12. (Mr. George.)

III. Architecture. (*a*) Shades and Shadows. 3. (*b*) Elementary Design. 4. (Mr. Gardner.)

IV. Chemistry. (*a*) Analytical Chemistry. 12. (Dr. Walker.) (*b*) Organic Analysis. 2. (Dr. Mulliken.)

V. Physics. (*a*) Mechanics, Light, and Electricity. 18. (Mr. Drisko.) (*b*) Heat. 12. (Prof. Clifford.) (*c*) Physical Measurements. 9. (Dr. Goodwin.)

VI. European History. 6. (Mr. Wentworth.)

VII. Modern Languages. (*a*) French. 4. (Mr. Blachstein.) (*b*) German. 21. (Prof. Vogel.)

VIII. Mechanism. 6. (Prof. Merrill.)

IX. Shopwork. (*a*) Woodwork. 14. (Mr. Merrick.) (*b*) Forging. 12. (Mr. Lambirth.) (*c*) Chipping and Filing. 5. (Mr. Smith.) (*d*) Machine-Tool Work. 23. (Mr. Smith.) (*e*) Metal Turning. 4. (Mr. Smith.)

STATISTICS.

The Corps of Instructors.

The catalogue of this year shows the number of instructors of all grades to be 135, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 172. This year's catalogue will show an increase of seven in the number of lecturers and some changes in the grades of professors and instructors. Allusion has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and eight-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1898–99	1899–1900
Professors	23	24
Associate Professors	7	9
Assistant Professors	23	21
Instructors	53	46
Assistants	28	35
Lecturers	30	37
Total	164	172

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,178. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865-66	72	1883-84	443
1866-67	137	1884-85	579
1867-68	167	1885-86	609
1868-69	172	1886-87	637
1869-70	206	1887-88	720
1870-71	224	1888-89	827
1871-72	261	1889-90	909
1872-73	348	1890-91	937
1873-74	276	1891-92	1,011
1874-75	248	1892-93	1,060
1875-76	255	1893-94	1,157
1876-77	215	1894-95	1,183
1877-78	194	1895-96	1,187
1878-79	188	1896-97	1,198
1879-80	203	1897-88	1,198
1880-81	253	1898-99	1,171
1881-82	302	1899-1900	1,178
1882-83	368		

Students by Classes.

The aggregate number of students for 1899–1900 is divided among the several classes as follows:

Fellows	2
Graduate students, candidates for advanced degrees	2
Regular students, Fourth Year	183
" " Third "	193
" " Second "	199
" " First "	303
Special students	296
Total	1,178

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows	2	...	2
Graduates of the M.I.T.	2	...	2
Fourth Year	183	75	258
Third Year	193	101	294
Second Year	199	94	293
First Year	303	26	329
Total	882	296	1,178

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	38	37	25	16	18	22	2	2	2	10	4	..	8	183*
3d " "	33	36	17	17	24	27	1	3	5	11	4	1	14	193
2d " "	28	40	18	20	16	35	5	2	4	9	6	..	16	199
Total . . .	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	10	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Courses.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st.	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d.	6	1	2	2	..	..	1	..	..	..	..	..	..	..
3d.	7	1	2	2	..	..	1	..	..	..	1	..	..	..
4th.	14	6	1	1	..	2	2	..	..	1	1	..	..	..
5th.	4	2	..	..	1	..	..	1	..	..	..	..	..	..
	35	10	5	5	1	2	4	1	0	1	2	0	0	0

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics	95	Language	117
Architecture	42	Mathematics	142
Biology	24	Mechanical Engineering	93
Chemistry	100	Mining Engineering	15
Civil Engineering	46	Naval Architecture	13
Drawing	125	Physics	159
Electrical Engineering	19	Political Science	68
English	95	Sanitary Engineering	2
Geology	37	Shopwork	73
History	75		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	318	241	127	42	728
Chemistry	350	154	95	81	680
English	315	242	26	11	594
French	144	77	53	...	274
Physics	...	284	243	162	689
German	70	202	122	...	394
Shopwork	22	107	53	63	245

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All regular Students.	Special Students.	Total.
Alabama	..	...	..	..	..	..	..	..
California	..	3	1	1	2	7	2	9
Colorado	..	..	1	1	1	3	4	7
Connecticut	..	2	6	0	11	25	4	29
Delaware	..	..	3	..	1	4	...	4
Dist. of Columbia	..	..	1	2	2	5	2	7
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	..	..	1	2	1	3
Illinois	..	8	6	9	4	27	9	36
Indiana	..	1	..	..	3	4	1	5
Iowa	..	3	1	1	..	5	1	6
Kentucky	..	1	2	..	..	3	1	4
Louisiana	..	..	1	..	..	1	..	1
Maine	..	6	..	4	8	18	7	25
Maryland	..	..	2	..	3	5	3	8
Massachusetts	4	117	124	130	189	564	167	731
Michigan	..	1	2	2	4	9	1	10
Minnesota	..	..	3	1	1	5	5	10
Missouri	..	..	1	2	2	5	6	11
Montana	..	..	..	..	2	2	1	3
Nebraska	..	1	..	..	2	3	..	3
Nevada	..	..	..	..	..	..	1	1
New Hampshire	..	7	3	2	9	21	8	29
New Jersey	..	2	1	2	1	6	6	12
New York	..	9	14	7	12	42	19	61
North Carolina	..	1	..	..	..	1	1	2
Ohio	..	4	7	2	7	20	7	27
Oregon	..	..	..	..	..	..	2	2
Pennsylvania	..	5	3	6	9	23	10	33
Rhode Island	..	2	3	4	13	22	10	32
South Carolina	..	..	..	..	1	1	..	1
South Dakota	..	..	..	..	1	1	..	1
Tennessee	..	..	..	1	2	3	1	4
Texas	..	1	..	..	1	2	..	2
Utah	..	..	1	2	2	5	1	6
Vermont	..	1	3	5	1	10	2	12
Virginia	..	1	..	..	1	2	..	2
Washington	..	2	..	1	..	3	1	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	..	2	1	4	3	7
Foreign Countries.								
Denmark	..	..	1	..	..	1		1
Dutch Guiana	..	..	..	..	..	..		1
England	..	..	..	1	..	1	..	1
France	..	..	..	1	..	1	1	2
Germany	..	..	..	1	..	1	..	1
Jamaica	..	..	..	..	1	1	..	1
Japan	..	1	..	..	..	1	1	2
Mexico	..	1	..	1	1	3	3	7
New Brunswick	..	..	1	1	1	3	..	3
Quebec	..	..	1	..	1	2	1	3
Russia	..	..	..	..	1	1	..	1
Turkey	..	1	1	1	..	3	..	3
Total	4	183	193	109	303	884	286	1178

Thirty-eight States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,178, 731 are from Massachusetts, or 62.1 per cent. of the whole; 127 are from other New England

States; 320 are from outside New England. Of these, 26 are from foreign countries.

A table showing the number of students in each year, from 1893, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Alabama	4	1	..	1	1	1	..
Arkansas	1	..	..	1	1	..	..
California	15	9	8	9	9	11	9
Colorado	..	2	7	7	8	8	7
Connecticut	28	27	24	30	26	29	29
Delaware	4	3	5	5	6	3	4
Dist. of Columbia	7	12	16	17	13	8	7
Florida	3	3	1	..	1	..	1
Georgia	3	2	2	3	4	4	3
Hawaiian Islands	2	..	..	..	..	1	..
Idaho	1	..	..	1	1	..	..
Illinois	39	36	42	45	40	51	36
Indiana	6	3	2	3	7	3	5
Iowa	13	10	12	14	12	7	6
Kansas	1	4	4	5	3	..	..
Kentucky	11	12	11	12	10	10	4
Louisiana	3	3	2	..	1	1	1
Maine	36	38	38	47	23	19	25
Maryland	4	4	9	9	8	8	8
Massachusetts	665	707	721	730	739	719	731
Michigan	7	8	7	6	5	9	10
Minnesota	11	9	5	7	8	11	10
Missouri	17	14	9	11	6	10	11
Montana	2	2	1	3	5	2	3
Nebraska	3	4	2	2	2	1	3
Nevada	2	2	..	..	..	..	1
New Hampshire	32	27	30	20	25	25	20
New Jersey	9	8	5	13	15	13	12
New Mexico	2	1	1	..	..	..	..
New York	57	59	64	60	62	68	61
North Carolina	..	..	..	1	1	2	2
Ohio	45	50	37	48	30	23	27
Oregon	1	1	1	4	3	3	2
Pennsylvania	31	37	36	42	41	34	33
Rhode Island	34	25	21	20	19	23	32
South Carolina	3	3	5	6	4	1	1
South Dakota	..	..	..	..	..	..	1
Tennessee	1	1	1	1	3	3	4
Texas	6	9	3	2	2	1	2
Utah	2	2	5	2	3	5	6
Vermont	5	3	5	7	11	12	12
Virginia	3	2	5	3	4	3	2
Washington	1	3	1	5	4	7	4
West Virginia	1	1	3	2	1	..	1
Wisconsin	11	6	7	6	6	8	7
Wyoming	..	..	..	1	..	..	..
Foreign Countries.							
Belgium	1	1	..	..	..	..	..
Brazil	..	1	1	..	..	..	..
Bulgaria	1	..	..	..	..	..	..
Cape Breton	..	..	..	..	..	1	..
Central America	1	..	1	..	..	..	..
Chile	..	1	1	1	..	..	..
Columbia	..	..	..	..	..	..	..
Cuba	..	1	3	2	1	1	..
Denmark	..	..	..	1	2	1	1
Dutch Guiana	..	..	..	..	..	1	1
England	1	..	1	2	2	4	1
France	1	..	..	1	1	1	2
Germany	2	1	..	..	1	1	1
Guatemala	..	..	..	..	..	..	..
Holland	2	2	..	..	..	..	..
Ireland	1	1	..	..	..	..	..
Jamaica	..	..	..	..	..	..	1
Japan	1	1	2	2	..	1	2
Mexico	1	1	1	3	6	7	7
New Brunswick	1	1	1	2	2	3	3
New South Wales	1	1	1	..	..	..	..
Nova Scotia	..	1	2	1	1	2	..
Ontario	4	4	2	2	..	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	1	1	1	..	..	..	..
Quebec	3	2	2	2	2	1	3
Russia	..	..	..	..	..	..	1
Scotland	..	1	..	..	..	..	..
Spain	1	1	1	..	..	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	..	1	3	1	3	3	3
Venezuela	1	1	1	1	..	..	..
Total	1157	1183	1187	1198	1198	1171	1178

Residence of Massachusetts Students.

It has been said that 62.1 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and eleven cities and towns are on the lists. The first column of

the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and twenty-eight and Suffolk two hundred and twenty pupils; Essex comes third, with one hundred and one; Norfolk fourth, with fifty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	4	Middlesex	30	228
Berkshire	3	7	Nantucket	1	1
Bristol	7	24	Norfolk	15	55
Essex	17	101	Plymouth	9	33
Franklin	4	5	Suffolk	2	220
Hampden	6	26	Worcester	13	27
			Total	111	731

The following is a list of the towns, forty-two in number, which send four or more students to the Ins

Boston	200	Salem	10	Fitchburg	5
Cambridge	42	New Bedford	9	Hyde Park	5
Newton	39	Gloucester	8	Middleboro	5
Somerville	24	Andover	7	Milton	5
Newburyport	23	Medford	7	Amesbury	4
Brookline	21	Melrose	7	Canton	4
Lowell	21	Winchester	7	Fall River	4
Chelsea	19	Worcester	7	Haverhill	4
Springfield	17	Everett	6	Holyoke	4
Brockton	13	Framingham	6	Pittsfield	4
Lawrence	13	Natick	6	Plymouth	4
Lynn	13	Peabody	6	Waltham	4
Malden	13	Taunton	6	Wellesley	4
Arlington	11	Concord	5		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and seventeen persons of unusual ages. These deductions

Period of Life.	1898–99.		1899–1900.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	2	..	2	..
16½ to 17 "	5	7	3	5
17 to 17½ "	16	..	16	..
17½ to 18 "	32	48	32	48
18 to 18½ "	45	..	57	..
18½ to 19 "	51	96	52	109
19 to 19½ "	54	..	34	..
19½ to 20 "	28	82	40	74
20 to 20½ "	16	..	28	..
20½ to 21 "	10	26	11	39
21 to 22 "	13	13	8	8
	272	271	283	283

leave two hundred and eighty-three as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1898–99.

From the foregoing it appears that the average age on entrance is eighteen years and eleven months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and seventy-one members of the class were distributed among the different periods of life as follows:

Under 20½	7
Between 20½ and 21	3
" 21 " 21½	13
" 21½ " 22	9
" 22 " 23	46
" 23 " 24	44
" 24 and over	49
Total	171

The special students this year constitute twenty-six per cent. of the whole body, as against twenty-six per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is eighty-one. Of these nine are our own graduates, three being candidates for advanced degrees.

Seventy-three are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Seventeen are graduates of Harvard University; four each of Wellesley College and Yale University; three each of Amherst College and Brown University; two each of McGill, Maine, and Vermont Universities, and Dartmouth College; while the following institutions are represented on our list by a single graduate each: Acadia, Denison, DePauw, Johns Hopkins, Minnesota, Princeton, Syracuse, and Wisconsin Universities; Ashville, Beloit, Boston, Central Turkey, Christian Brothers, Colby, Davidson, Delaware, Doane, Hobart, Lafayette, Monmouth, Neuchatel, New

Hampshire, Randolph-Macon, R.I. Agricultural and Mechanic Arts, Robert, Simpson, Smith, St. John's, St. Joseph's, Southern Kentucky, Southwestern Presbyterian, Trinity, Vassar, and Villanova Colleges.

Women as Students at the Institute.

The number of women pursuing courses with us is fifty-three. Of these, five are graduates of colleges. Of the total number, five are regular students of the fourth year; five of the third year; six of the second year; six of the first year. Thirty-one are special students. Of the sixteen regular students of the upper classes, three take Course IV., Architecture; six, Course V., Chemistry; two, Course VII., Biology; four, Course VIII., Physics; one, Course IX., General Studies. Of the special students, fifteen devote themselves to Biology, eight to Chemistry, three to Architecture, two to General Studies, one to Physics, one to Naval Architecture, and one to Drawing.

Statistics of Examinations.

Of the 1,178 students of the present year, 414 were not connected with the school in 1898–99. Of these, 275 were admitted as regular students of the first year upon the basis of their entrance examinations. The 139 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 275 who were thus admitted to the Institute on examination, and have taken their place in the school, 74 were admitted on examination, but have not entered the school.

In the case of the 275 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	203
" on one condition	49
" on two conditions	18
" on more than two conditions	5
	275

Forty-seven applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Albany, Buffalo, Chicago, Cincinnati, Concord (N.H.), Denver, Detroit, Exeter (N.H.), Indianapolis, Kansas City (Mo.), Louisville, Manlius (N.Y.), New York, Philadelphia, Pittsburgh, Portland (Me.), Poughkeepsie, St. Louis, St. Paul, Springfield (Mass.), and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	.	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	.	..	..	1	..	..	..	..	26
1874	10	4	1	1	.	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	.	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	28	3	5	13	..	18	3	2	6	..	..	..	..	103
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	17	..	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	..	33	3	4	6	9	3	..	7	200
1899	30	38	9	22	21	.	32	2	2	1	9	1		8	172*†
Totals	405	488	168	176	244	1	384	36	32	74	79	25	8	34	2,148
Deduct names counted twice. ...															12
Net total.....															2,136

* Deducting names counted twice.
† Including two persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1898, to May 11, 1899.

The first meeting of the Society of Arts for the present year was held on Oct. 13, 1898. Fourteen meetings have been held, and the following papers have been read: "Bacteria in Milk; including their Rôle in Butter and Cheese Making," by Mr. S. C. Keith, Jr.; "Wool, with Practical Features that Enter into the Forming of a Wool Tariff," by Mr. Henry G. Kittredge; "Metropolitan Water Supply," by Mr. Frederic P. Stearns; "Geology of the Wachusett Reservoir," by Prof. W. O. Crosby; "Repeated Stresses," by Prof. Jerome Sondericker; "A Description of the Construction and Other Features of the South Terminal Station," by Mr. George B. Francis and Mr. Henry J. Conant; "Modern Methods of Steel Forging," by Mr. H. F. Porter; "The Diesel Motor," by Col. E. D. Meier; "The Construction of the University of Virginia, Old and New," by Mr. Theodore H. Skinner; "An American Railway in Columbia," by Mr. Francis R. Hart; "The Middlesex Fells Observatory," by Mr. George L. Hosmer; "A New Form of Induction Coil," by Mr. T. B. Kinraide; "The Present State of Metallurgy of Lead in the United States," by Prof. H. O. Hofman.

The meeting on December 22 was for the purpose of opening the new Pierce Building to the interested public.

A number of new members have been added during the year. At the close of the year 1897–98 the number of Life Members was 53. Five have died this year, leaving the present number 48.

The number of Associate Members a year ago was 323.

Of these, 1 has died and 6 have resigned, but 17 have been elected, and the present number is 333. The Life Members who have died during the year are Hon. John Cummings, Waldo O. Ross, Henry Davenport, Hon. F. W. Lincoln, and Col. Henry Lee. One Associate Member, Capt. Alfred E. Hunt, of Pittsburgh, served in the war with Spain, and brought back his regiment without the loss of a man, but has just died from the effects induced by exposure in the trying campaign.

The Board of Publication of last year was reappointed, and the "Technology Quarterly" has been conducted as before, with Dr. Bigelow as responsible editor. During the year twenty articles have been published in the "Quarterly," besides the "Proceedings of the Society of Arts" and "Review of American Chemical Research," which have appeared regularly. Of the contributed articles eight are papers that have been read before the Society of Arts, the remaining twelve having been presented by title only. Among the most notable of the latter is an extended paper by Prof. S. W. Holman, entitled "On the Telescope-Mirror-Scale Method; Adjustments and Tests."

At the last meeting of the year, the thirty-seventh annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Frank W. Hodgdon, and Charles T. Main were reëlected members of the Executive Committee, and Mr. A. T. Hopkins was reëlected Secretary for the year 1899–1900.

Respectfully submitted,

ARTHUR T. HOPKINS,
Secretary.

DEC. 12, 1899.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1898, to May 11, 1899.

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Respectfully submitted,

ARTHUR T. HOPKINS,
Secretary.

DEC. 12, 1899.

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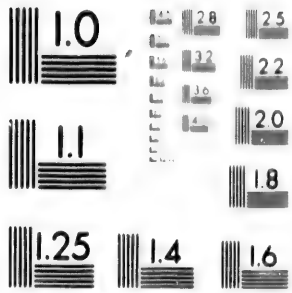

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NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

24:1

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1899.

Under the will of the late Edward Austin the Institute received, after payment of the United States succession tax of sixty thousand dollars, three hundred and forty thousand dollars, the income from which is to be used for special purposes designated in the will. Edward W. Hooper, Esq., most kindly and generously gave to the Institute the full sum paid by it for legal expenses incurred in connection with the settlement relating to this will and amounting to eighteen hundred dollars.

Augustus Lowell, Esq., has given fifty thousand dollars to constitute, in his own words, the nucleus of a fund, of which the income shall be used for the benefit of the Teaching Staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the Government may from time to time see fit to adopt. The name attached to this gift is simply "The Teachers' Fund." The value of such an endowment is very great. The need of it has been keenly felt, and it is earnestly desired that the hope expressed by Mr. Lowell may be realized and the amount so generously devoted by him to these purposes be increased in the future by gifts from others.

In addition to the large amounts previously paid over by the executors of the will of the late Hon. Henry L. Pierce thirty thousand dollars more have been received.

Similarly the trustees of the J. W. and Belinda Randall Charity have added twenty-five thousand dollars to their previous gift, and the executors of the late Mrs. Julia B. H. James have made a further payment of six thousand dollars. From the Susan E. Dorr estate fourteen hundred and sixty-seven dollars and nineteen cents have been received, and the Ann White Dickinson Scholarship Fund has been increased by five hundred and ninety-four dollars and forty-one cents. Mrs. Wm. B. Rogers has given two hundred dollars for the purchase of periodicals, and from other friends have come gifts amounting in all to eight hundred and sixty-one dollars and thirty-four cents.

There has been an increase in the income for general purposes from stocks and bonds of more than eleven thousand dollars and also a gain in the amounts received from rents and interest, but to offset these the sum paid for salaries has increased about eight thousand dollars, and with the new building general expenses as well as the cost of fuel, water, and electricity have all become greater. In general expenses, there have been included some large items such as furniture and electrical wiring and fixtures. In connection with the transfer of certain departments to the Henry L. Pierce building extensive changes were made in the other buildings and the payments for these were charged to repair account. The result is an adverse balance of nineteen thousand eight hundred and eighty-three dollars and forty-two cents in the current expense account. There has, however, been a net gain on securities sold of nineteen thousand seven hundred and eighty-eight dollars and sixty-nine cents.

The net increase in the property of the Institute for the year is four hundred and thirty-seven thousand one hundred and fifteen dollars and twenty-six cents. It should, however, be noted that of this sum nearly three hundred and ninety-three thousand dollars are for special purposes and not available for general expenses.

Securities Sold or Paid, W. B. Rogers Memoral Fund.

$16,000	Kansas City, Cl. and Springfield R.R. 5s	1925	11,940.00
1,000	Kansas City, Mem., & Birmingham R.R. 4s.	1934	830.00
2,000	Kan. City, Mem., & Birmingham R.R. Inc. 5s.	1934	720.00
42,000	Chi., Burlington & Quincy R.R. Conv. 5s.	1903	58,601.05
1,600	Republican Valley R.R. 6s	1919	1,600.00
255 Sh.	Detroit, Grand Rapids & Western R.R., Pf.		10,072.50
			$83,763.55

Received.

$25,000	Atchison, Topeka & Santa Fe R.R. Gen. 4s.	1995	24,470.00
7,000	Chesapeake & Ohio R.R. 5s.	1939	8,267.50
38,000	Chi., Junct. & Union Stock Yards 5s. transferred from General Funds	1915	42,022.00
			$74,759.50

Securities Sold or Paid, General Account.

$15,000	Chi., Bur. & Quincy R.R. Conv. 5s.	1903	20,928.95
3,000	Bur. & Missouri R.R. Non-exempt 6s.	1918	3,000.00
2,000	Brookline Gas Co. 5s.	1913	2,110.00
2,000	Lowell, Law. & Haverhill St. Ry. 5s.	1923	2,100.00
29,000	Walter Baker Co. Lt'd. 4½s.	1903	29,000.00
38,000	Chi. Junc., & Union Stock Yards 5s. transferred to Rogers Fund	1915	42,022.00
25,000	Illinois Steel Conv. 5s.	1910	26,250.00
55 Sh.	Chi., Bur. & Quincy R.R.		6,545.00
55 "	Chi., Rock Island & Pacific R.R.		5,885.00
¼ "	Pepperell Manf. Co., New		115.50
15 "	Consolidated Gas Co., New York		2,745.00
7 "	Lowell Gas Co.		1,891.75
7 "	Lawrence Gas Co.		805.00
5 "	First National Bank, Baltimore		500.00
25 Rights	Boston Real Estate Trust		307.36
55 "	New England Tel. & Tel. Co.		151.25
			$144,356.81

Securities Bought or Received as Legacies, General Account.

25 Sh.	Boston Real Estate Trust		25,005.00
$25,000	Chi. Terminal & Transfer Co. 1st 4s.	1947	22,987.50
25,000	Illinois Steel Co. Conv. 5s.	1910	24,950.00
25,000	Illinois Steel Co. Non-conv. 5s.	1913	24,290.00
250,000	New York Revenue 3½s.	1899	250,000.00
43,000	Chesapeake & Ohio R.R. 5s.	1939	50,770.00
50,000	Chi. Junc. & Union Stock Yards Inc. 5s.	1907	50,000.00
			$448,002.50

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance Sept. 30, 1898		110,567.63
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500 00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,304.00	
" " " " scholarships (students' fees)	8,257.25	
" " " " Joy " [1898, 50.00]	250.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers, 1898, etc.,	652.75	
" " " " Library	480.00	
" " " " general purposes	23,643.98	
" " Rogers Memorial Fund	10,877.63	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Fund	400.00	
" " Rotch Architectural Fund	1,000.00	
Letter Box Fund	75.00	
Students' fees	207,118.00	
State Scholarships	4,000.00	
United States Act of 1862	5,717.56	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Biological Fund, 1898	143.50	
Laboratory supplies and breakages	9,546.57	
Rents, per Table (page 92)	16,115.81	
Gifts	2,861.34	
Interest	12,890.74	
Boston University	1,150.00	
Sale printed Lecture Notes	2,463.60	
		347,576.22
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase James Savage Fund	126.10	
" Dalton Graduate Chem. Sch'p Fund	221.28	
" Willard B. Perkins Fund	243.20	
" Susan Upham Fund	49.84	
" James H. Mirrlees Fund	7.34	
" Letter Box Fund	18.25	
Teachers' Fund	50,000.00	
Edward Austin Fund	340,000.00	
Susan E. Dorr Fund [add'l 1,467.19]	1,718.01	
Ann White Dickinson Fund ["]	594.41	
		392,978.43
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	30,000.00	
James Fund, additional	6,000.00	
J. W. and Belinda Randall Fund, additional,	25,000.00	
		61,000.00
SECURITIES SOLD OR PAID. GENERAL FUND, page 83.		144,356.81
" " " Rogers Memorial Fund		83,763.55
SUNDRIES.		
Income credited to Bond Premium Acct.	2,429.00	
Income credited to Rogers Bond Premium Acct.	578.00	
Boston Art Students' Association, on acc't	666.67	
Students' Notes paid	155.00	
Students' deposits	150.00	
		3,978.67
		$1,153,221.31

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1899.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 92)	239,920.62	
" paid from Gifts	458.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 93)	33,678.83	
General Expenses, per Table (page 93)	23,183.31	
Fire Insurance	2,626.35	
Biological Instrument Department	143.50	
Fuel	7,181.73	
Water	2,370.30	
Gas	2,133.70	
Electricity	1,431.08	
Printing and Advertising	3,057.67	
" Lecture Notes	1,681.38	
" Annual Catalogues and Reports	2,470.06	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 92)	39,337.38	
Society of Arts	777.01	
Interest paid A. Lowell, Trustee	1,000.00	
Mech. Eng. & Applied Mechanics Department, Improvements	4,395.31	
Omaha Exposition	33.41	
		367,459.64
[Expenses more than Income, $19,883.42]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 83)		448,002.50
Rogers Memorial Fund		74,759.50
Henry L. Pierce Building, Trinity Place, on acct.		52,992.99
Boiler and Power House, Trinity Place		22,341.74
Fire Repairs, Engineering Building and contents		16,462.63
SUNDRIES.		
Notes Receivable	100,000.00	
Funds of 1898, used	455.81	
		100,455.81
Cash balance, Sept. 30, 1899		61,746.50
		$1,153,221.31

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1899:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00
6,000.00	New York & New England R.R. 6s.	1905	6,000.00
3,800.00	Republican Valley R.R. 6s. . . .	1919	3,800.00
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00
2,000.00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00
25,000.00	Atchison, Top. & S. Fe R.R. 4s. .	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	38,000.00
	Advance to Bond Premium account .		10,941.84
	Bonds and Stocks		249,324.34

INVESTMENTS, GENERAL ACCOUNT.

$11,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	11,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00
6,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	5,100.00
3,000.00	Chicago, Mil. & St. Paul R.R. 7s .	1905	3,000.00
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00
6,000.00	West End Street Ry. 5s	1902	6,000.00
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00
26,000.00	New York & New England R.R. 6s.	1905	26,000.00
8,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	8,000.00
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00
121,000.00	Walter Baker Co. Lt'd. 4½s . . .	1903	121,000.00
25,000.00	Chi. Terminal & Transfer Co. 1st. 4s.	1947	22,987.50
25,000.00	Illinois Steel Co., non-conv. 5s . .	1913	24,290.00
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00
50,000.00	Chi. Junc. & Union S. Yards inc. 5s.	1907	50,000.00
250,000.00	New York Revenue 3½s	1899	250,000.00
	Advances to Bond Premium account,		26,385.43
	Bonds		895,762.93
	Amount carried up		$1,145,087.27

Amount brought up $1,145,087.27

STOCKS.

SHARES.					
198	Boston & Albany R.R.	par	100	40,683.00	
194	Morris & Essex R.R.	"	50	14,690.00	
40	New York & Harlem R.R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00	
100	N.Y., New Haven & Hartford R.R.	"	100	17,000.00	
50	Boston & Maine R.R. common	"	100	8,300.00	
25	Boston & Providence R.R.	"	100	6,625.00	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00	
50	Fitchburg R.R. Pf.	"	100	4,800.00	
90	Pullman's Palace Car Co.	"	100	10,200.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
40	Cambridge Gas Light Co.	"	100	7,000.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
5	First Nat. Bank of Baltimore	"	100	793.30	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	
50	American Bell Telephone Co.	"	100	12,750.00	
55	New England Tel. & Tel. Co.	"	100	6,604.69	
					301,339.83

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00

Amount carried up $1,465,550.80

Amount brought up		1,465,550.80

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place,	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Engineering Building B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Henry L. Pierce Building, Trinity Place		152,875.46	
Boiler and Power House, Trinity Place		22,341.74	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
			1,164,356.76
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80

SUNDRIES.

Notes Receivable	378,500.00	
Boston Art Students' Association	10,999.99	
Students' Notes	1,250.50	
Cash Balance, Sept. 30, 1899	61,746.50	
		452,496.99
		$3,119,588.35

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	75,000.00	
James Fund	146,500.00	
		651,090.11
Amount carried up		$651,090.11

Amount brought up		651,090.11
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,209.82	
James Savage Fund	13,678.55	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,615.98	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,803.53	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,726.82	
Ann White Dickinson Fund	40,594.41	
Dalton Grad. Chem. Fund	5,753.09	
Willard B. Perkins Fund	6,323.20	
		252,025.16
OTHER TRUSTS.		
Charlotte Billings Richardson Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,295.81
Susan E. Dorr Fund		7,138.60
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch " Special " Prize Fund		5,200.00
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund, balance		82.12
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	300.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	780,000.00	
John W. Carter Legacy, 1898	6,250.00	
M. I. T. Stock Account	809,027.77	
		1,625,577.77
		$3,119,588.35

Comparative Statement of Funds, etc.

	Sept. 30, 1898.	Sept. 30, 1899.
Trusts for general purposes	620,090.11	651,050.11
" " Salaries	107,600.00	107,600.00
" " Scholarships	251,145.14	252,025.16
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,245.97	1,295.81
Susan E. Dorr Fund	5,420.59	7,138.60
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Moses Kimball Legacy	5,000.00	
Benj. P. Cheney "	10,000.00	
John Foster "	10,000.00	10,000.00
Henry L. Pierce "	750,000.00	780,000.00
John W. Carter "	6,250.00	6,250.00
Susan G. Coolidge Devise	14,500.00	
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund	63.87	82.12
Biological Instrument Fund	143.50	
Students' Deposits	150.00	300.00
Notes Payable	20,000.00	20,000.00
Fire Insurance, Engineering Building	16,462.63	
M. I. T. Stock Account	779,622.50	809,027.77
	$2,682,473.09	$3,119,588.35
Increase, Consisting of:		
Bequests for Special Purposes, etc. (See page 84)	392,978.43	
Gifts and Bequests for General Purposes. (See page 84)	61,000.00	
Students' Deposits	150.00	
Net gain on Securities sold	19,788.69	
		473,917.12
Less Funds of 1898, used	455.81	
" Fire Insurance, Engineering Building, expended	16,462.63	
" Expenses more than Income	19,883.42	
		36,801.86
		$437,115.26

Sept. 30, 1899.	
651,050.11	
107,600.00	
252,025.16	
7,000.00	
37,378.78	
1,295.81	
7,138.60	
5,000.00	
25,000.00	
5,200.00	
5,260.00	
10,000.00	
780,000.00	
6,250.00	
340,000.00	
50,000.00	
82.12	
300.00	
20,000.00	
869,027.77	
119,588.35	
73,917.12	
36,801.86	
37,115.26	

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,304.00
" " Scholarships	8,257.25
" " " James Savage Fund	400.00
" " Charlotte B. Richardson Fund	1,495.15
" " Rotch Prize Funds	400.00
" " Rotch Architectural Fund	1,000.00
" " Library	480.00
" " General Purposes	23,643.98
" " Increase of Funds	898.58
" " Advances to Bond Premiums	2,429.00
	$43,307.96

From Dividends, Bank Stocks	1,294.90
" State Tax returned on Bank Stocks	238.30
" Bonds	28,366.28
" Dividends, Railroad Stocks	5,735.06
" " Coal and Gas Stocks	1,622.57
" " Manufacturing Stocks	1,495.00
" Telephone Stocks	1,078.35
" Real Estate Stocks	3,477.50
	$43,307.96

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,877.63
Credited to Advances Bond Premiums	578.00
	$11,455.63

Received Income from Railroad Bonds	11,455.63
	$11,455.63

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		100.00	
Land and Building, Clarendon St., on account		9,250.00	
34 Commonwealth Avenue, 1 year	2,200.00		
Less Annuity under Will,	1,000.00		
" Tax	390.90		
	1,390.90		
		809.10	
Use of Rooms and Gymnasium		1,165.39	
		16,624.49	
Less Tax and Repairs, Cambridge		508.68	
			16 115.81

Department Supplies.

Civil Engineering	3,5[illegible].21	
Mechanical Engineering	2,825.80	
Applied Mechanics	1,683.32	
Mining	2,553.49	
Architecture	2,576.02	
Chemistry	10,193.08	
Physics	6,714.69	
Biology	1,786.01	
English	969.91	
Modern Languages	114.83	
Geology	1,001.42	
Naval Architecture	758.06	
Drawing	109.80	
Mathematics	641.73	
Military	68.17	
Periodicals	1,937.86	
Workshops	1,430.98	
		39,337.38

Salaries.

Instruction	191,129.25	
Administration	22,422.59	
Labor	26,368.78	
		239,920.62

General Expenses.

Furniture		6,076.43
Electrical Wiring and Fixtures		3,250.16
Postage		2,298.48
Legal Fees		1,892.13
Janitors' Supplies		1,541.77
Stationery and Office Supplies		1,266.85
Engine Room Supplies:		
Oil	332.71	
Sundries	324.62	
Waste	69.32	
		726.65
Entrance Examinations		611.05
Express		601.21
Washing		555.31
Diplomas		433.03
Shades		422.44
Clocks, for Time S[illegible]		390.00
Books, Supplies, etc., f[illegible] General Library		299.96
Sundries		295.55
Telephone & Telegraph Co.		267.84
Ice		266.05
Motor, Carpenter Shop		235.00
Lowell School of Design		212.64
High Service Pipe		206.67
Bicycle Shed		196.30
Gymnasium		193.90
Blue Books		193.59
Locks, Students' tables, Mech. Eng.		165 97
Removing Ashes		147.00
Telephone Line		91.92
Type-writing Machine		90.25
Union Safe Deposit Vaults		75.00
Glass		60.33
Street Watering		48.98
Graduation Exercises		43.85
Western Union Telegraph Co.		27.00
		23,183.31

Repairs.

Department Improvements:		
Civil Engineering	432.42	
Mechanical Engineering	570.55	
Mining	777.32	
Architecture	85.35	
Chemistry	2,618.93	
Physics	1,183.96	
Biology	15.91	
English	7.50	
Modern Languages	30.63	
Geology	359.57	
Naval Architecture	90.28	
Drawing	198 50	
Workshops	1,488.61	
		7,859.53
Rogers Building		14,485.73
Fire Escapes		2,873 26
Walker Building		2,795.03
Eng. Building, A and B		2,104.35
Steam Fitting		1,127.33
Walk to Entrance Eng. Building		1,000.00
Roofing Vaults Walker Building		573.56
Roofing Vaults Rogers Building		436.80
Gymnasium		391.21
Boiler Room		32.03
		33,678.83

BOSTON, December 7, 1899.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1899, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
CHARLES C. JACKSON,
WILLIAM L. PUTNAM,
} *Members of the Auditing Committee.*

BOSTON, December 7, 1899.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1899, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances. The vouchers for all items paid out are accounted for. I have also examined the payments for the weekly pay-roll, and find them to be correct. The amounts charged to the students agree with the Secretary's records, and the sums received therefor are also duly accounted for.

Yours truly,

EDWIN A. STONE,
Accountant.

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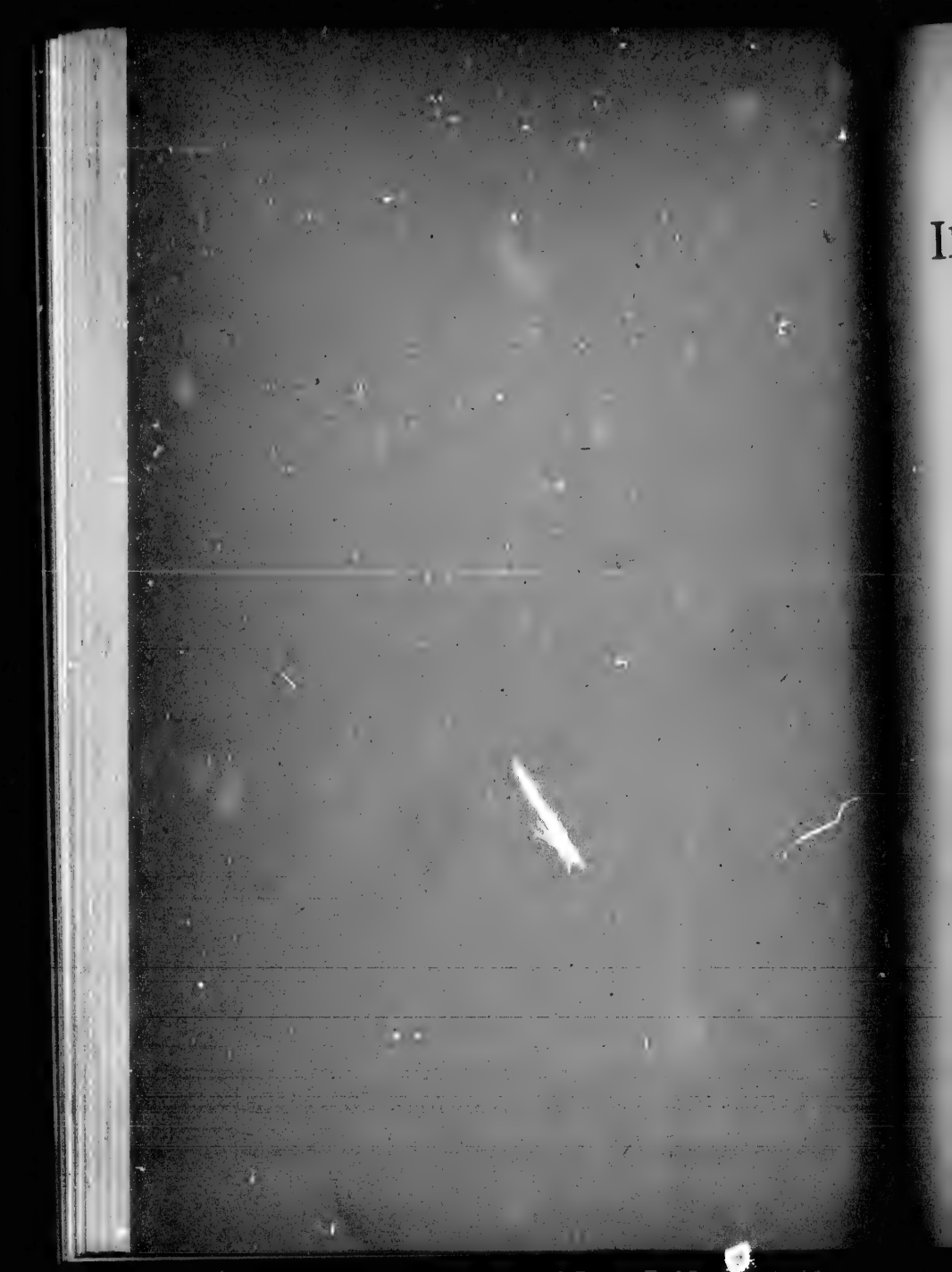

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 12, 1900.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.
WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
ELIOT C. CLARKE.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
ARTHUR T. LYMAN.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.

On the Part of the Commonwealth.

His Excellency Hon. W. MURRAY CRANE, *Governor.*
Hon. OLIVER W. HOLMES, *Chief Justice of the Supreme Court.*
Hon. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }
ALEXANDER S. WHEELER. FRANCIS H. WILLIAMS.
HOWARD STOCKTON. THOMAS L. LIVERMORE.
A. LAWRENCE LOWELL.

Finance Committee.

WILLIAM ENDICOTT. CHARLES C. JACKSON.
DAVID R. WHITNEY. NATHANIEL THAYER.
CHARLES F. CHOATE.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Committee on the Lowell School of Industrial Design.

PERCIVAL LOWELL. JOHN D. RUNKLE.
WILLIAM H. LINCOLN.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. ELIOT C. CLARKE.
CHARLES F. CHOATE. DESMOND FITZGERALD.
JOHN R. FREEMAN.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. FRANCIS BLAKE.
DESMOND FITZGERALD. JAMES P. TOLMAN.
EBEN S. DRAPER.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.
ROBERT S. PEABODY.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. ELIHU THOMSON.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. NATHANIEL THAYER.
FRANK A. HILL. THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Biology.

SAMUEL CABOT. FRANCIS BLAKE.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

To the Members of the Corporation of the Massachusetts Institute of Technology:

Gentlemen: I have been with you but little more than two months, and the report which I have the honor to present at this time contains, in the nature of the case, little beyond the details furnished by the heads of the several departments. Later, with longer acquaintance, I shall ask your attention to certain recommendations regarding the work of the departments, which I feel at this time that I am not prepared to make. I wish to congratulate the Corporation on the thorough and earnest spirit of work, among both Faculty and students, which, even in so short a time as I have been here, has been evident to me.

I am glad to acknowledge, also, cordial help from my predecessor, President Crafts. It has been a source of pleasure both to the Faculty and to myself that he still remains with us as an adviser and friend, and continues to pursue his chemical researches in a private laboratory in the Walker Building.

Since your last annual meeting the Corporation has lost by death three of its members: Mr. Augustus Lowell, Mr. John E. Hudson, and Mr. Thomas Gaffield. Mr. Lowell became a member of the Corporation in 1873, Mr. Gaffield in 1896, and Mr. Hudson in 1899. In the death of these three members of the Corporation we have lost those whose counsel and whose friendship have been of great assistance to the Institute. Mr. Lowell in particular has been long identified with it. He has been since 1883 a member of the Executive Committee, and during seventeen years he has devoted his time and his thought unsparingly to the Institute, and has supported it most generously with his means. In the very short acquaintance which I had with him he im-

pressed me with his strength and breadth of character, and I felt when he died a great sense of loss. Memorials of Mr. Lowell and Mr. Hudson were presented at the last meeting of the Corporation and will be found in the "Technology Review" for January.

Walker Memorial Building.

The completion of the Henry L. Pierce Building practically exhausted the land at present available for building purposes, that on Garrison street being too remote. On the other hand, the removal of the tracks of the Boston & Providence Railroad offered an unequalled opportunity for securing additional land contiguous to our own. After prolonged negotiations, the Executive Committee, with the approval of the Corporation, secured a tract of 51,000 square feet, completing the rectangle bounded by Clarendon and Stanhope streets, Trinity place, and the passageway along the present Engineering Building "A." This purchase has direct relation to a matter which I consider of immediate importance, and to which I now call your attention.

Most of those interested in a thoughtful way in the educational institutions of the United States feel that the question of physical culture is one which as yet has been successfully dealt with in very few of our colleges and technical schools. The present attitude of most institutions of learning toward the instruction of their students in the care of health is either one of absolute neglect, or else one which fosters to an undue degree certain athletic games. In the first case the result is that most students receive no instruction as to exercise, diet, and the proper care of their bodies; while in the second case, a few students are encouraged, often at the expense of scholarship and health, to a system of severe training that is out of all proportion to normal life.

The Institute of Technology maintains a small gymnasium and provides an instructor in gymnastics for those who care to avail themselves of his services. Military instruction oc-

cupying three hours a week is given to the first-year class, and in the course of the year one lecture is given to them on the care of the body. Up to this time, however, we have not undertaken to conduct a department of physical culture, or to supervise in any way the athletic contests into which our students enter.

It is a singular thing that, while the development of modern science has been used with such success in all that pertains to the intellectual side of our development, we have been slow to avail ourselves in the same way of that knowledge which helps to prevent disease, and to conserve health. The time has come when it seems not only of vital importance, but of absolute necessity to provide a system of rational instruction in the care of the body which shall conserve the health of our students. To quote from a man who is not likely to give undue weight to the matter of physical training: "Since vigorous health and its accompanying high spirits are larger elements of happiness than any other things whatever, the teaching how to maintain them is a teaching that yields in momen to no other whatever." At present we are not giving such instruction, nor are we providing our students with a rational system of physical culture. I have, therefore, to recommend that we inaugurate at the earliest possible moment a department of physical culture.

At the head of this department should be a man familiar with student life, a trained physician, who should spend his whole time in the care and supervision of the department.

As a centre for the life of this department, we must have at an early date the Walker Memorial Building. It should be not a gymnasium in the narrow sense, but a building for physical culture and direction, in which, under the care of the head of the department, students may be introduced by the laboratory method to a knowledge of the proper laws of health. A system of physical culture could be begun which for first-year students would be compulsory. The main

features of this system would be, in addition to such lectures as the head of the department might give, the following:

(1.) Each man entering the first-year class should have a strict physical examination, and should receive in accordance therewith directions from the head of the department as to exercise, diet, and the proper method of preserving health. A careful record of these examinations and of subsequent examinations would of themselves form a most valuable series of observations.

(2.) Under the direction of the head of the department each student so examined should spend a prescribed time daily in good weather in open-air exercise. Such exercises or sports should be adapted to the need of the individual, so that, for example, the student who is inclined to be flat-chested or who is inclined to pulmonary disease may be directed to one thing, and one who suffers from an excess of fat may be sent to another. An athletic field would be a convenient but not necessary part of this system.

(3.) At times when the weather does not permit exercise out of doors, students should be required to exercise for a prescribed amount of time in a well-lighted and well-ventilated room.

(4.) Only such competitive sports should be encouraged as may secure out-door exercise, and particularly those, such as track athletics, which afford opportunity to the individual, rather than those which depend on expensive and time-consuming team work. In general, all such sports should be conducted in a way not only consistent with good scholarship, but subordinate to it.

The alumni, who began two years ago to secure subscriptions for the erection of such a building, have already obtained pledges for more than one-third of the amount desired. With a definite statement from the Corporation as to what may be available for a site for this building, together with a guarantee to furnish a man of proper qualities to direct such

a department, I feel sure that the remainder of the fund will be subscribed promptly. I have therefore to urge most strongly that the alumni of the Institute be informed that, in case the sum of one hundred thousand dollars is subscribed before July 1, 1901, the Corporation will set aside from the land recently purchased on Trinity place a site for this building, and that it will provide a director of a department of physical culture. There is no other need at this moment which in my mind is so pressing, and it seems to me absolutely necessary to dispose of this question before taking up others which will soon demand our attention. I feel that this matter is of such importance that any other recommendation which I might make to you at this time would be secondary to it.[1]

Attendance.

I have to report an attendance at the present time in the Institute of twelve hundred and seventy-seven (including four non-resident) students, the largest number which it has ever known. The increase in number has taxed the resources of some departments to the utmost, and any considerable increase above the present attendance will require additional facilities and additional space.

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[1] The following votes were passed by the Corporation at a special meeting held December 26:

Resolved, That the President is authorized to state to the Alumni that the Executive Committee will recommend that the Corporation set aside 10,000 square feet of the land on Trinity place, corner of Stanhope street, or, if preferred, 48,000 feet on Garrison street, for a site for the Walker Memorial building, on condition that $100,000 is subscribed by July 1, 1901, for the erection of the building. The Executive Committee will also provide a suitable man to conduct a department of physical culture.

Resolved, That the Faculty of the Institute be requested to confer with representatives of the Alumni and to submit to the Executive Committee a plan for the Walker Memorial building and for its use.

Changes in the Faculty and Instructing Staff.

Professor Wells has been granted a year's leave of absence after a long period of continuous service. It is hoped that he may return with much improvement in health.

Captain William Baird succeeds Lieutenant James Hamilton as Professor of Military Science and Tactics. Assistant Professors Ripley, Vogel, and Woodbridge have been appointed Associate Professors of Economics and Sociology, Modern Languages, and Heating and Ventilation respectively.

Professor Ripley graduated at the Institute in the course of Civil Engineering in 1890, and remained a year for special work in economics. He subsequently held a fellowship at Columbia University, and received the degree of Doctor of Philosophy in 1892. He was appointed Instructor in Political Economy in the same year, Assistant Professor in 1895, and has shown marked ability in his work as a teacher and an investigator.

Professor Vogel was appointed Instructor in Modern Languages in 1888, Assistant Professor in 1892, and has devoted several of his vacations to continuing his philological studies in Germany.

Professor Woodbridge was a member of the class of 1880, and Instructor and Lecturer from 1883 to 1895, when he was appointed Assistant Professor. His special studies in the direction of heating and ventilation have drawn him into professional practice on a large scale, and the Institute is fortunate now in securing a larger share of his time and attention that he has heretofore been able to give.

Mr. Homer Albers, LL.B., has been appointed Lecturer in Business Law, succeeding Mr. Joseph Willard.

Messrs. Charles W. Berry, William D. Coolidge, William T. Hall, George L. Hosmer, Joseph C. Riley, and Alpheus G. Woodman, Assistants of last year, have been promoted to the rank of Instructors.

After the close of the school year Mr. Myron L. Fuller,

Instructor in Geology, was called to the position of Assistant Geologist on the United States Geological Survey. He has been a faithful, vigorous, and successful worker, and he was appreciated for the breadth of his knowledge as well as for his interest in the welfare of the Institute.

By the resignation of Dr. William H. Walker from his position as Instructor in Analytical Chemistry, the Institute has lost the services of an earnest and efficient teacher who was achieving marked success in his work.

Leave of absence has been granted to Mr. Carl H. Clark, Instructor in Naval Architecture, for one year to enable him to obtain more extensive practical experience.

Other Instructors and Assistants of last year who have terminated their connection with the Institute to engage in professional practice or for advanced studies elsewhere are: Messrs. E. M. Bragg, W. B. Russell, and E. W. Rutherford, in Mechanical Engineering; A. A. Blanchard, L. P. Chapin, M. S. Sherrill, and L. J. Seidensticker, in Chemistry; F. H. Watts, in Civil Engineering; J. G. Coffin, in Physics; A. L. Davis, F. L. H. Kimball, and E. Walker, in Mining Engineering.

Dr. Charles Hyde Warren, of Yale University, has been appointed Instructor in Geology, in place of Mr. Fuller; Mr. Walter S. Leland, of the class of 1896, becomes Instructor in Naval Architecture, during the time of Mr. Clark's leave of absence.

The following Assistants have been appointed: R. Wilfred Balcom, John W. Brown, and James H. Walton, Jr., in Chemistry; Edward E. Bugbee, Howard C. Plummer, and William L. Stevens, in Mining Engineering; Charles M. Fosdick and Arthur B. White, in Civil Engineering; Cyrus H. Hapgood, in Physics; Walter H. James, Albert S. Merrill, Timothy C. O'Hearn, and Lawrence S. Smith, in Mechanical Engineering; Carlton Ellis, in Oil and Gas Analysis.

Teachers' Fund.

It is a source of much gratification to the Institute that the teachers' fund for aid in cases of retirement, disability, or death, has been doubled by the generous bequest of Mr. Augustus Lowell. No gift to an institution of learning is of more value than a fund for the assistance and retirement on salary of members of the instructing staff who, by reason of ill health or advancing age, are unable to continue longer in the active service of the Institute.

Degrees.

The increasing number of students entering with advanced standing or remaining a fifth year at the Institute, and at the same time the increasing demand for men trained in more than one line of engineering work, have led the Faculty to consider the regulation of candidacy for the degree in two departments at the same time. The result is embodied in the following rule:

An applicant for the degree of Bachelor of Science in two courses at the same time must have made application for such candidacy not later than November 1 next preceding his graduation. Such applications shall be granted only in the case of students who have previously anticipated fourth-year subjects in one or both of the courses in question to such an extent that they have ample time for the work proposed. All such applications shall be referred to a special committee of the Faculty to report as to the eligibility of the candidate, and, in case his application is approved, to have the oversight of all of his work for the remainder of the year, and to report to the Faculty at the close of each term as to the character of the work done. The committee shall decide as to the time and manner of carrying on the thesis work required.

A careful study of our advanced degree requirements has led the Faculty to discontinue the announcement of the

degree of Doctor of Science, and to define the requirements for the degree of Doctor of Philosophy as follows:

The degree of Doctor of Philosophy certifies to high attainments of a grade which qualifies the recipient as a scientific investigator and teacher. The course of study leading to this degree is mainly one of experiment and research, accompanied by such other theoretical subjects as may be useful adjuncts to the main scheme of work. The candidate must pursue his studies and researches under the direction and oversight of the Faculty for at least two school years, furnishing from time to time such evidences of progress as the Faculty may require. His attendance must be continuous except in cases of absence previously approved by the Faculty for the purpose of conducting researches and investigations in the field. He must present a thesis embracing the results of an extended original investigation, and must pass such final examinations as the Faculty may require. No Assistant or Instructor in the Institute, while engaged as such, shall be accepted as a candidate for the degree of Doctor of Philosophy.

Scholarships.

The Executive Committee assigned for the present year $5,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 178, while 129 submitted applications for the 40 State scholarships. Ninety-one of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 216. Of these, 28 have received scholarships to the amount of full tuition, 129 others have received smaller amounts, averaging somewhat more than $100 each. In accordance with the Act of the Legislature authorizing division of State scholarships, 26 of the 40 were so divided, thus increasing the number of recipients to 66.

On recommendation of a special committee appointed by

the Faculty, the following votes have been passed in relation to the income of the Austin Fund:

(1.) That teachers who are known to be thoroughly prepared for undertaking graduate work be accepted as candidates for scholarship aid on the same terms with graduate students, and that their applications be presented to the Standing Committee on Advanced Degrees and Fellowships. Such applicants will, in general, be college graduates.

(2.) That, in general, teachers applying for scholarship aid be not required to conform to the regular courses if they have presented definite, well-considered plans of study approved by the Faculty. It is understood that such applicants will be expected to have done good work at the Institute for a year, and to present such evidence of their need of aid as the Committee on Scholarships may require. It is expected that their applications will be made through the heads of the respective departments.

(3.) That aid be allowed towards meeting the cost of the Institute Summer Courses or Summer Schools in exceptional cases on application by the head of the department to the President.

Graduate Scholarships.

The graduate scholars of the current year are Messrs. Elbert G. Allen, S.B., Stephen F. Gardner, S.B., and Isaac Osgood, S.B., all of the class of 1900, and Frederic A. Watkins, S.B., of the class of 1899; Eric H. Green, A.B., A.M., of Brown University; Carlton R. Rose, Ph.M., of the University of Michigan. Messrs. Allen, Gardner, and Osgood are candidates for the Master's degree. Messrs. Green, Rose, and Watkins are special students in Chemistry, Mining Engineering, and Electrical Engineering, respectively.

Fellowships.

Mr. Gorham P. Stevens, of the class of 1898, retains the Swett fellowship, and is continuing his studies at the Atelier

Pascal in Paris. His admission to the École des Beaux-Arts as twenty-third out of sixty candidates shows the high quality of his work.

The Savage fellowship has been awarded to Mr. Paul L. Price of the class of 1900, who is continuing his architectural studies at the Institute.

Besides these fellowships of long standing, the income from the Austin fund has enabled us to make the following additional appointments:

Mr. Arthur A. Blanchard, of the class of 1898, and for the past two years Assistant in Theoretical Chemistry, Mr. Louis P. Chapin, a graduate of the University of Minnesota and since 1897 Assistant in General Chemistry, and Mr. Miles S. Sherrill, of the class of 1899, Assistant in Analytical Chemistry, are taking courses at the University of Leipzig. Mr. Joseph G. Coffin, of the class of 1898, for the past two years Assistant in Physics, is a graduate student at Clark University. Mr. George B. Ford, of the class of 1900, is taking advanced work in Architecture at the Institute.

The following reports are made on the fellows of last year:

Mr. George K. Burgess, of the class of 1896, has held the Savage fellowship for the last two years. He has taken a course of study in the University of Paris under the immediate charge of Professor Lippmann. His subject of investigation has been a new mode of determining the gravitation constant. The apparatus, a description of which was published in the "Comptes Rendus" of Aug. 21, 1899, was of such extreme sensitiveness — surpassing in this respect any previous device — that his investigations were subject to considerable delay. Mr. Burgess expects to take his final examinations next summer. At present he has an appointment as Instructor in Physics at the University of Michigan.

Mr. H. W. Gardner, Instructor in Architecture, was absent in Europe for a year on a grant from the Austin Fund. The greater part of his time was spent in Italy in making careful measured drawings of certain monuments that had special

bearing on his future work at the Institute. In particular he studied the landscape gardening of a number of famous villas. At Lante, near Viterbo, he was allowed full scope to measure and draw as he pleased. He has made a complete drawing of the famous gardens of this villa. Mr. Gardner's own report will soon be ready, when an exhibition of the work that he has done will be given.

Advisers.

During the year the system of advisers has had some additional development. This system was introduced seven years ago, and, while data as to the results are necessarily meagre, it is believed to have worked reasonably well. Heretofore the new students of each year — about four hundred and fifty — have been distributed somewhat uniformly among the entire instructing staff. Last spring the Faculty adopted the plan of appointing a definite committee of student advisers, numbering about thirty members, selected with special reference to the service desired. The number of students assigned to each adviser is proportionately increased, but it is not likely to prove burdensome. During the first weeks of students' connection with the Institute, when many of them are meeting unaccustomed responsibilities, and when mistakes may have far-reaching consequences, it is of great importance — difficult though the task is — for us to secure adequate acquaintance with them.

"Technology Review."

The publication of the "Technology Review" has been continued by an editorial committee representing the Association of class secretaries, and the great success of the "Review" in every respect reflects the highest credit on its management. In spite of a discouraging deficit at the end of the first year, the committee has, without any sacrifice of the high standard set by the early numbers, made such improve-

ments and retrenchments as to make the publication nearly self-supporting. It is to be hoped that the subscription list of the "Review" will be so maintained and increased by all who are interested in the Institute as to relieve the editorial board of a burdensome part of their present loyal service.

Paris Exposition.

As stated in the last report, the Institute was requested by the officials of the United States Commission for the Paris Exposition to be one of two institutions for exhibiting higher education in engineering and architecture in the United States. The Executive Committee authorized the necessary expenditure, and a committee of the Faculty carried out the preparation of the exhibit.

The amount of space allotted to the Institute was at first so limited that an effective exhibit was deemed out of the question; but by the courtesy of Director Rogers a special assignment of hanging space on an important façade was made which permitted an effective display of large architectural designs. The remainder of the exhibit consisted chiefly of photographs of a standard size mounted in wing-frames, and of portfolios with text and photographs illustrating the work of our engineering departments. Liberal use was made of the various Institute publications, and effective aid was rendered by Institute graduates connected with the Massachusetts Commission or resident in Paris. Besides this main exhibit special collections of minerals and other building stones were made through our department of geology. The material for these was collected from all parts of the country by Professor Crosby and Mr. Fuller, and at the close of the Exposition came into the possession of the Institute. The work of the department of economics in the preparation of the exhibit of the Massachusetts State Board of Health is referred to on page 28. All the members of the Faculty who visited the Exposition during the summer brought back most gratifying reports of the success of our exhibit.

The awards made by the Exposition authorities included the *grand prix* for the Institute in the class of Special Industrial and Commercial Education, gold medals in the classes of Higher Education, Special Education in Fine Arts, and Working of Mines, Ore Beds, and Stone Quarries. A gold medal for the exhibit of the Student Coöperative Society was also awarded. Within a few days we have been much gratified to receive a request on behalf of the French government for the presentation of a number of the large architectural designs to the École des Beaux-Arts.

Eclipse Expedition.

Last May the Institute sent a party under the charge of Professor Burton to Washington, Ga., to observe the total eclipse of the sun. While the Civil Engineering Department is not fully equipped to carry on all kinds of astronomical work, such work being not essential for the instruction of the civil engineer, it was felt that the opportunity should not be lost. The party consisted of Professor Burton, Professor Robbins, and Mr. Hosmer, of the Civil Engineering Department; Professor Bartlett, of the Mathematical Department; Mr. H. W. Smith, of the Physical Department; and Mr. Walter Humphreys. The work of the civil engineering staff consisted in the precise determination of the times of contact. A full account of the expedition has been published by Professor Burton in the "Technology Quarterly" and in the "Technology Review."

The Departments.

Courses I. and XI., Civil and Sanitary Engineering. — For the sake of uniformity, a slight change has been made in the arrangement of the studies in the Civil Engineering Department. The force of instruction remains as before, except that Mr. F. H. Watts has resigned his position as Assistant to accept a position on a railroad in the West, and that, on account of the large number of students taking courses in

surveying and topographical drawing, two additional Assistants have been required. The number of students in the second-year drawing room is 107, of which number, 41 are taking the course in Mining Engineering, and 4 the course in Landscape Architecture.

The demand for graduates in Civil Engineering has been larger this year than ever before. Since last May applications have been received for not less than 69 men, excluding a number of applications for men to take temporary positions during the summer. One of the recent graduates of the department is engaged in the construction of water-works in Corea, and another in engineering work in Havana.

The thirteenth session of the Summer School of Civil Engineering was held at Sunapee, N.H., in June last, and was attended by ten students. The work was in direct charge of Instructors K. S. Sweet and G. L. Hosmer, assisted by Messrs. Russell, Thurber, and Delano of the class of 1900. Professor Barton also attended the school for a short time and made several geological trips with the students. The work was of the same character as that usually performed, consisting of base-line measurement, triangulation, plane table and other topographical work, together with hydraulic measurements in rating meters and gauging the flow of streams and practice in taking soundings.

Course II., Mechanical Engineering. — The new option in Heating and Ventilation in the Mechanical Engineering course has now been in effect for one year. In this option, besides the work in heating and ventilation, the students attend a short course in the Biological Department upon sanitary hygiene, and a course in the Physical Department upon electric motors. The course in Heating and Ventilation is given by Associate Professor Woodbridge, assisted by Mr. Charles F. Park, Instructor in Mechanical Engineering. Six students of the class of 1901 and one graduate have selected this option.

The department has also been called upon to provide for

a considerable additional amount of work in connection with a new option in the course in Chemistry and with another in the course in Physics. In both cases courses in mechanism and drawing are given, as well as other work in mechanical engineering.

Course III., Mining Engineering and Metallurgy. — The large increase in the number of students taking this course led, two years ago, to the installing of a number of small individual plants for concentrating, and one year ago to the division of the class into three sections which receive laboratory instruction in rotation from Professors Richards, Hofman, and Lodge. These changes have now been subjected to a year's trial and have enabled the department not only to handle the increased number of students, but to do so with improved results. By a redistribution of work, all the lectures in mining are given by Professor Richards, and all those in metallurgy by Professor Hofman. On page 23 reference is made to work done in metallography by students in this department, under supervision of the department of Chemistry.

The laboratory is constantly made more efficient by the introduction of new machines and by improved adjustments and appliances adapted to the old machines. By the installation of ten little amalgamation pans, ten students can in a single afternoon try a series of tests. When the results are tabulated, the best mean result is at once apparent, and the evils of excess and deficit are easily pointed out. Several new hydraulic classifiers as well as a small riffle-table have been installed.

The appointment of an assistant for library and museum work is making both these collections of greater value to the students.

The Summer School of Mining was held last June in New Jersey and Eastern Pennsylvania. From Dover visits were made to the Richard mine, where the rich and extensive ore bed and the fine new compressing plant were studied; and

to the Andover and Joseph Wharton Mines of Hibernia, where the students were much interested in studying the Ball-Norton magnetic concentrating plant. A visit was also made to Edison's great magnetic separating plant with all its ingenious labor and power saving devices. The next visit was to Pottsville, Pa., for a geological view of the coal measures. Here the Mahanoy City Colliery and breaker were made special subjects of study. In the valley of the Lehigh visits were made to the mine of brown-iron ore at Ironton, the cement mines and works at Copake. The iron blast furnace at Hokendauqua, the zinc furnaces of the New Jersey Zinc Company, South Bethlehem, and the open hearth furnaces, forging presses, and great gun shops of the Bethlehem Steel Company, were also visited.

Course IV., Architecture. — In the option in Landscape Architecture, now in the second year of its existence, there are ten students, five in the second and five in the third year. As yet there appears to be no reason for a change in the course of instruction. We have daily proofs of the unrivalled advantages that we can offer for this study in our close proximity to the Arnold Arboretum, where much of our regular work is done, and to Brookline and other suburbs where many fine estates have been thrown open to our students through the courtesy of their owners.

The option in Architectural Engineering graduated its first class last year, and it is a pleasure to report that good positions were found for all its members. The importance of this field is fully acknowledged, and the number of pupils now pursuing the course proves its attractiveness. Our graduates are more and more realizing the need of a year's uninterrupted study in some one field, and return to take advantage of the opportunities offered by the department for advanced work.

The Rotch prizes, given annually to students in the department, were this year awarded to Mr. G. B. Ford and Mr. J. L. Little, Jr. Both students are taking graduate work.

Mr. Ford and Mr. P. L. Price, a graduate from the option in Architectural Engineering, are candidates for the Master's degree. The Boston Society of Architects has awarded prizes in books of the value of fifty dollars each to Mr. C. H. Stratton and Mr. W. R. Kattelle, both of the class of 1900.

The drawings sent to the Paris Exposition were selected to present a characteristic exhibit of the work done in an American school of architecture. The honor with which they have been distinguished by the French government has been referred to elsewhere. The drawings of Professor Despradelle's "Beacon of Progress," a full description of which was published in the "Technology Review" for October, 1900, have been accorded equal distinction.

The work of the students in the summer school of Architecture has again been the study of the old colonial buildings. The interior of King's Chapel was first measured, and here was given the necessary drill in the systematic plotting of lines and measurements, the use of lead strips in getting the forms of mouldings, etc. The work done here proved that many errors had been allowed in the published drawings of the building. From Boston Professor Homer took his class to Providence, where through the courtesy of the Rhode Island School of Design they obtained an excellent room for day and evening work. After ten days spent in making a great number of measured sketches, the class returned to the Institute, and devoted the remaining days to putting the material in hand into accurately made drawings.

Courses V. and X., Chemistry and Chemical Engineering. — The course in Chemistry has undergone material modification during the past year. The attention of members of the department has been for some time past called to the need that graduates of this course have felt for some knowledge of the principles of mechanical engineering. Many of them whose work is in technical or manufacturing chemistry are so situated as to be called upon to superintend the care of machinery or mechanical operations. To meet these needs

a series of optional studies has been arranged, with the advice and coöperation of the Department of Mechanical Engineering. While the course was being thus revised, it was thought also worth while to arrange other series of optional studies, extending through the four years, which would, without sacrificing general training, admit of a certain amount of specialization along lines in which there is a demand for graduates from this department. Option 1 is essentially a course in Chemistry with elementary courses in mechanism and valve gears (with drawings), and a course in engines and machines. Option 2 includes almost all the laboratory courses, general and special, and affords training for those who wish to pursue purely chemical lines of technical work. Option 3 affords a preparation for work in municipal or so-called sanitary chemistry. Option 4 specializes along metallurgical lines, in the fourth year of the course. Option 5 presents a course in pure chemistry, which, like the course in pure physics, is intended to prepare students to become teachers, especially in higher institutions, or to undertake research work.

The equipment of the department has been increased by the fitting up of a research laboratory for Professor Crafts.

The number of students taking analytical chemistry is 135. Of these 80 are taking qualitative analysis and 53 are taking quantitative analysis. Of the latter, three are graduate students from other colleges and two are teachers. The class-room instruction in theoretical chemistry has been materially improved by the working out of a systematic series of experiments which are now shown in connection with the lectures. Investigations in metallography have been continued during the past year by students of the fourth year electing this subject for thesis work. Although the microscopic outfit is in excellent condition for research work, yet, if the present demand for theses in this subject should continue, the laboratory facilities for heat measurements must be greatly increased.

The need of a room to be used as a chemical museum is pressing. At present the department can hardly encourage the presentation of chemicals or models of apparatus, as it lacks a suitable place for exhibition or even for storage.

The summer course in organic chemistry was unusually well attended. Of the thirteen students enrolled, seven were regular students of the Chemical course. Compared with the total number of students in the course, this number is small, probably on account of the expense. It is, nevertheless, to be regretted that so few of the better students of the class avail themselves of this opportunity to anticipate a large part of their fourth-year work, and thus to gain much-needed additional time for their theses.

Courses VI. and VIII., Electrical Engineering and Physics. — In the course of lectures on general physics, which is given to all regular students of the second year, very considerable modifications have been made during the past few years, in order to present better the recent advances in this science. The rapid enlargement of the whole subject and the fact that the character of these advances is rarely such as to render the older knowledge less important will soon necessitate an extension of the time allotted to it.

A noteworthy addition to the instruction in the course in Electrical Engineering which goes into effect during the present term is a brief series of lectures by Professor Clifford upon the mathematical theory of the propagation of electric waves, a subject which has assumed great practical importance during the past year. This course has been made alternative with that upon railroad signals.

An addition to the work in Electrical Engineering is caused by the establishment of a new option in Heating and Ventilation in the course in Mechanical Engineering, the students in which receive additional instruction in the application of electricity to mechanical purposes. The work has been undertaken by Professor Puffer, and the course on dynamo-electric measurements given to students of the

course in Mechanical Engineering, and the course in Mining Engineering and Metallurgy has been transferred to Mr. W. L. Smith, Instructor in Electrical Engineering.

In the course in Physics an option has been established in Electro-Chemistry. It will include, first, an extended series of exact measurements on electrolytic conduction, transference, polarization, electrolysis, etc.; second, advanced work, including electro-deposition of metals, the electrolytic separation of metals, conductivity of fused electrolytes, electrolysis at very high temperatures, and reductions in the electric-arc furnaces. The option will also include complete efficiency tests of accumulators and of various electrolytic cells. For this work considerable additional equipment will be necessary, and the laboratory will have to be furnished with currents of several hundred amperes for running the electric furnaces. Already the importance of such work has been recognized in several of the polytechnic schools in Germany; but, so far as is known, a laboratory thus equipped for electro-chemical work is unique in this country.

The laboratory of heat measurements has been much hampered by the unexpected increase in the size of the classes, for which both room and teaching force are inadequate. There is an increasing demand for instruction in the accurate measurement of high temperatures and calorific powers. The latest call is for work in connection with the electrical furnace. In view of these demands, the most pressing problems in the branch of physics to which this laboratory is devoted are the study of the methods for maintaining and measuring very high temperatures, and the treatment of the problems in heat which bear upon the development of the modern cold storage systems and methods.

Professor Bartlett, who for the past nine years has done the greater part of the arduous work of examining the laboratory note-books of students in General Physics, has been relieved, and the work has been given to Mr. M. de K. Thompson, Assistant in Physics. Every one knows that the efficiency of

laboratory instruction depends to great extent upon the faithfulness with which this work is done, and that there are few duties which are more tedious. The laboratory owes a great deal to Professor Bartlett's long and painstaking service.

The laboratory of acoustics is so noisy and is so largely devoted to office purposes that its work is rendered very difficult. The optical laboratory is without a suitable room. Indeed, the disadvantages under which the department labors from want of room, and which have been referred to in the President's reports for a number of years, grow more and more serious.

Course VII., Biology. — Important changes have been made in the programme of studies in this department (and to some extent in the biological subjects in the courses in chemistry and sanitary engineering) by which more time is given to bacteriology and industrial biology, more time is reserved for thesis work in the final term, and a new subject is introduced. These changes have been made necessary by the rapid growth of bacteriology and its applications to engineering and the arts.

A new course in municipal sanitation is an outgrowth of that in sanitary biology. It includes the study of the sanitary aspects of pavements and dust-nuisances; of street cleaning; of the utilization or disposal of garbage and refuse (ashes, dirt, paper, and other combustible wastes); of the smoke-nuisance; of public parks and playgrounds; of public supplies, such as water, gas, milk, and meat; and of public buildings or institutions, such as theatres, libraries, latrines, markets, baths, gymnasia, prisons, almshouses, etc.

A brief course in the hygiene of heating and ventilation, given by Professor Sedgwick, has been introduced this year in connection with the new option in the department of Mechanical Engineering.

Assistant Professor Hough has continued and extended his important researches on the physiology of muscular work and fatigue, by new and fruitful experiments with the ergo-

graph, and an account of his latest work is just issuing from the press. In the spring he published in the "American Physical Education Review" a valuable paper on the "Flow of Lymph and its Relation to Muscular Exercise," and also as a separate monograph an extended and critical review of the theory and practice of the Swedish system of gymnastics, which has excited much favorable comment, and has recently been incorporated as a special monograph in the Annual Report of the United States Commissioner of Education.

The bacteriological laboratory is so inadequate to the needs of the classes as to constitute a serious drawback to effective work. If the recommendations made last year in the President's report cannot be adopted, temporary relief, at least, should be given by the assignment of more space in the Henry L. Pierce Building.

Course IX., General Studies: Economics, History, English. — A special effort has been made during the past year to furnish the students in the third-year class in political economy, which consists of nearly all regular third-year students, with a larger amount of printed matter. The syllabus distributed weekly is now four pages instead of one. The work is also being concentrated upon a smaller number of topics, each of which is of genuine interest to the engineer and the man engaged in practical business. In the development of this plan, and with a view of enlisting on the part of the student a more personal interest, it is proposed to offer options during the second term, permitting the student to select from courses on banking and exchange, finance, railroad economics, the relation of laborers and employers, methods of wage payments, merchant marine, etc.

For the more special work of the General Course, a large number of diagrams have been mounted and the collection of graphic material has been enlarged. The student is also engaged in the plotting of diagrams from day to day and week to week on current financial or commercial phenomena, which are published in the reports of the United States

Treasury Department, or by boards of trade and banking organizations. For example, graphic records have been made of the available cash balance in the United States Treasury, receipts and expenditures of the government, the rate of foreign exchange, the weekly clearing house returns, both of New York and Boston, the exports of wheat and flour, the exports and imports of specie, the movement of money to and from the interior as kept by New York banks.

During the past summer one of the students in the class in anthropology collected data relating to the social and physical characteristics of negroes on a Louisiana plantation. Over three hundred persons were examined and the data tabulated on cards. The material thus obtained will be used for a thesis.

At the request of the Board of Paris Exposition Managers of Massachusetts, and also of the United States Commission of the Paris Exposition, a large number of diagrams were prepared under the supervision of Professor Dewey. A considerable part of this work was done by students of the Institute, and this series of charts, as a rule, received the highest approval of the Exposition Jurors.

Professor Dewey's work on the Financial History of the United States will soon be published in the American Citizen Series, edited by Professor Hart of Harvard University.

A new course on recent history and political conditions in Eastern Asia was given for the first time in the spring term of 1900. Beginning with a general geographical and historical survey, the class studied, from standard authorities, official publications, and current literature, various phases of the Eastern question, — more particularly the expansion of Russia and Russian interests on the Pacific, — recent events in China looking towards railway and industrial development of the country, together with the probable establishment there of spheres of European control, and the commercial and political interests of the United States in these and other

trans-Pacific changes. The class was regularly open, as an option, only to the members of the fourth-year class in the course of General Studies. Hereafter it may perhaps be offered with advantage to students in other courses.

The fact that more attention has of late years been paid to English in the best secondary schools makes in every class a more marked difference between students trained in these schools and those less fortunate. This difficulty is now met by dividing sections according to grade as early in the term as this can be done intelligently and the proficiency of the students judged by actual work. This wide difference in proficiency at entrance makes of highest value the system of assigning special work in English to any student, no matter what his standing otherwise, who shows marked weakness in composition. The system of examination of first-year note-books in chemistry is now arranged on a basis which brings it more closely in touch with the regular work in composition; and all along the line the effort is being made to insure that the written work which students do in their scientific study and outside of formal classes in composition shall not encourage bad literary habits or undo the good of the course in rhetoric. The courses in advanced composition and in literature, given primarily for students in the course in General Studies, are still attended as electives by students from other departments, and in this way English is brought constantly more closely in touch with the strictly technical side of Institute work.

Course XII., Geology. — The total membership of the different classes taught in the department during the year was 439.

Professor Crosby has spent about three months among the mines of southwestern Missouri, and he has brought to the Institute a very full and representative collection of the zinc and lead ores and their associated minerals. Probably there is no other collection of the minerals of that region which surpasses this one in completeness and educational value.

Course XIII., Naval Architecture. — The department of Naval Architecture has arranged for a short course of lectures on Ordnance and Armor to be given by Professor Philip R. Alger, U. S. N., of the Naval Academy at Annapolis, in February or March.

The drawing room for students of the third and fourth years in the department is now arranged for fifty tables, and the room is lighted by a very satisfactory method proposed by Professor Puffer, and installed under his supervision.

Mathematics. — No marked changes have occurred in the work of the Department of Mathematics during the past year. The absence of Professor Wells for the present school year has been elsewhere referred to. It has not been found necessary to make an additional appointment in his place, as members of the staff have been able to take additional work to the extent necessary. It was noted in the last President's Report that the number of sections in calculus had been increased from twelve to fourteen. This year the considerable increase in the size of the entering class has required an increase from sixteen to eighteen sections in algebra. Moreover, the average size of first and second year sections is such as to make a further increase in their number desirable in the near future.

The Runkle Library of Mathematics is proving very helpful to instructors and students, and as time passes is more and more used.

Modern Languages. — The efficiency of the Department of Modern Languages has been increased by frequent departmental meetings, by dividing systematically and carefully, between the two terms, the work allotted to every class, and by a greater uniformity of purpose and method in the instruction of all classes and sections.

On account of the increasing demand for instruction in Spanish, there has been for three years no instruction in Italian, which used to alternate with Spanish. In view of this fact Professor Rambeau recommends that there shall be

two options in Spanish every year, an elementary course and a higher one, and that optional instruction in the elements of Italian be also given every year. Moreover, it seems desirable that the Institute should offer to the students of all departments optional advanced courses, not only in French and German, but also in Spanish and Italian.

Shopwork. — Professor Schwamb reports that the total registration at the workshops this year is 373; the total number of students, 272, — a marked increase over any previous year. In spite of the fact that a considerable number of students anticipate shopwork in our summer courses, the space available in the machine shop is now taxed to its utmost capacity, and several special students have necessarily been refused admission. A small instruction room for use in connection with the machine shop has proved of much value, and a similar arrangement is recommended for the wood-working and forging.

Summer Courses.

The attendance at summer courses this year was as follows:

Mechanical Drawing and Descriptive Geometry. 43. (Prof. Faunce.)
Mathematics: Analytic Geometry. 16. (Mr. Carter.)
Architecture. (*a*) Shades and Shadows. 3. (*b*) Elementary Design. 5. (Mr. Skinner.)
Chemistry. (*a*) General Chemistry. 38. (Mr. Phelan.) (*b*) Analytical Chemistry. 1. (Dr. Walker.) (*c*) Organic Analysis. 7. (Dr. Mulliken.) Organic Chemistry. 3. (Dr. Mulliken.)
Physics. (*a*) Mechanics, Light, and Electricity. 20. (Dr. Wendell.) (*b*) Heat. 19. (Prof. Clifford.) (*c*) Physical Laboratory. 14. (Dr. Goodwin.)
Modern Languages. (*a*) French. 7. (Mr. Dike.) (*b*) German. 14. (Dr. Dippold.)
Mechanism. 9. (Prof. Merrill.) Mechanical Engineering Drawing. 19. (Mr. Park.)
Shopwork. (*a*) Woodwork. 5. (Mr. Merrick.) (*b*) Forging. 13. (Mr. Lambirth.) (*c*) Chipping and Filing. 9. (Mr. Smith.) (*d*) Machine-Tool Work. 24. (Mr. Smith.)

THE LIBRARIES.

The total number of additions to the libraries during the year 1899–1900 was 4,520. After deducting books purchased to replace volumes that have been worn out or lost, books counted twice, etc., the total net increase in the size of the library amounts to 3,702 volumes, 497 pamphlets, and 66 maps. The distribution of this increase among the departmental libraries is shown in the following table:

Table of the Net Accessions for the Year 1899–1900, with the Cost of the Same, and the Total Contents of the Libraries of the Institute, Sept. 30, 1900.

Libraries.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library: General	320	158	. .	$122 41[1]	4,574	3,724
General Library: English	136	. . .	. .	173 71	2,671	38
General Library: Modern Languages	192	. . .	5	276 60	834	23
General Library: Military Science	8	1	. .	4 69	150	7
Totals	656	159	5	$577 41	8,229	3,792
Architecture	191	. . .	. .	438 15	2,639	210
Biology	186	14	. .	279 37	2,371	433
Chemistry	388	51	. .	599 47	7,944	1,597
Engineering	670	142	60	1,121 00	9,492	3,783
Geology	143	5	. .	170 83	2,674	827
History and Economics	653	60	. .	519 91	10,157	3,225
Mathematics	129	2	. .	230 69	1,035[2]	176
Mining	264	21	1	394 24	2,589	429
Physics	422	43	. .	647 46	6,705	750
Margaret Cheney Room	. . .	. . .	. .	. . . . .	616	13
Totals	3,702	497	66	$4,978 53	53,851	15,235

[1] Including books placed in the Secretary's office.
[2] Exclusive of the Runkle Library.

The total number of serial publications of all kinds that we receive regularly now amounts to 871. The distribution of the periodicals and other serial publications among the de-

partmental libraries, and their cost, are shown by the following table:

Table of Periodicals and other Serial Publications received during the Year 1899–1900.

Libraries.	Number Received.					Estimated Cost.			
	Gifts.	Paid by Dept.	Periodical Account.		Totals.	Paid by Department.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	31	3	20	35	89	$23 50	$48 00	$123 88	$195 38
Architecture	1	3	4	32	40	6 28	9 60	191 17	207 05
Biology	20	6	8	38	72	21 10	19 20	223 90	264 20
Geology	15	1	8	5	29	2 50	19 20	20 95	42 65
Chemistry	78	15	15	43	151	48 16	36 00	217 99	302 15
Engineering	39	33	68	53	193	71 75	163 20	219 91	454 86
History and Economics	40	30	6	62	138	59 20	14 40	210 34	284 00
Mathematics	....	....	2	15	17	.....	4 80	56 31	61 11
Mining	18	1	21	25	65	179 00	50 40	85 60	137 79
Physics	9	5	31	29	74	17 41	74 40	144 95	236 76
Lowell School of Design	....	....	....	3	3	.....	.....	10 00	10 00
							$439 20	$1,505 00 439 20	
Totals	251	97	183	340	871	$251 75		$1,944 20	$2,195 95

Publications.

The following list comprises the books and papers published by members of the Faculty and Instructing Staff during the past year. The publications are arranged according to departments, and the authors' names according to seniority.

Courses I. and XI. Civil and Sanitary Engineering.

G. F. Swain: Technical Education at the Massachusetts Institute of Technology. Popular Science Monthly, July, 1900.

C. F. Allen: Railroad Curves and Earthwork.

A. E. Burton: The M. I. T. Eclipse Expedition to Washington, Ga. Technology Review, July, 1900.

A. E. Burton, with A. G. Robbins and G. L. Hosmer: The Eclipse Expedition of the Massachusetts Institute of Technology to Washington, Ga. Technology Quarterly, September, 1900.

G. L. Hosmer: Summer School of Engineering at Lake Sunapee, June, 1900. Technology Review, October, 1900.

Course II. Mechanical Engineering.

G. Lanza: Applied Mechanics. New edition.

G. Lanza: Road Tests of Locomotives. Proceedings of the Central Railroad Club.

C. H. Peabody: Manual of the Steam Engine Indicator.

J. Sondericker: Notes on Graphical Statics. Revised edition.

E. F. Miller: Testing the Strength of Materials. Four articles in Machinery for February, March, April, and July, 1900.

E. F. Miller (Editor): Results of Tests made in the Engineering Laboratories, Number XII. Technology Quarterly, September, 1900.

S. H. Woodbridge: Car Sanitation. Report of the Public Health Association for 1899.

S. H. Woodbridge: Railroad Sanitation. Proceedings of the New England Railroad Club for November, 1899.

S. H. Woodbridge: Warming and Ventilation of Mills. Proceedings of the New England Cotton Manufacturers' Association for April, 1900.

Course III. Mining Engineering and Metallurgy.

R. H. Richards: Review of the Literature on Ore Dressing in 1898. The Mineral Industry, 1899, Vol. VIII., pp. 694–701.

R. H. Richards: Ore Dressing. The Mineral Industry, 1899, Vol. VIII., pp. 744–779.

H. O. Hofman: Notes on the Metallurgy of Iron and Steel. Printed for the use of students at the Institute.

H. O. Hofman: Recent Improvements in Lead Smelting. The Universal Industry, 1899, Vol. VIII., pp. 394–410.

H. O. Hofman: The Temperatures at which Certain Ferrous and Calcic Silicates are formed in Fusion, and the Effect upon these Temperatures of the Presence of Certain Metallic Oxides. Transactions of the American Institute of Mining Engineers, 1899, Vol. XXIX., pp. 682–721.

R. W. Lodge: Assaying Telluride Ores for Gold. Technology Quarterly, 1899, Vol. XII., pp. 171–174.

Course IV. Architecture.

E. B. Homer: A Day in Provence. Technology Review, January, 1900; and American Architect, Nos. 1279 and 1280.

Courses V. and X. Chemistry and Chemical Engineering.

H. P. Talbot with M. Henze: Darstellung der geometrisch-isomeren symmetrischen Di-methylaethylene aus der Tiglinsäure und Angelicasäure. Liebig's Annalen der Chemie, Vol. CCCXIII., p. 228.

A. A, Noyes with A. A. Blanchard: Lecture Experiments Illustrating the Electrolytic Dissociation Theory and the Laws of the Velocity and Equilibrium of Chemical Change. Journal of the American Chemical Society, Vol. XXII., p. 726.

A. A. Noyes: The Exact Relation between Osmotic Pressure and Vapor Pressure. Zeitschrift für physikalische Chemie, Vol. XXXV., No. 5; and Physical Review, Vol. XII., No 2.

A. A. Noyes: A Modification of the Usual Method of Determining Transference-Numbers and an Investigation of the Influence of the Concentration on their Values in the case of Some Tri-ionic Salts. Zeitschrift für physikalische Chemie, Vol. XXXV., No. 6; and Physical Review, Vol. XII., No. 1.

A. A. Noyes, Editor: Review of American Chemical Research for 1900. Reviewers: H. P. Talbot, F. J. Moore, A. G. Woodman, G. W. Rolfe, A. A. Noyes, W. O. Crosby, C.

H. Warren, Henry Fay, H. O. Hofman, J. F. Norris, H. M. Goodwin, E. H. Richards, A. H. Gill, and F. H. Thorp.

A. H. Gill: A Short Handbook of Oil Analysis. Second edition.

A. H. Gill with W. O. Adams: On Hübl's Iodine Method for Oil Analysis. Journal of the American Chemical Society, Vol. XXII., pp. 12–14.

Ellen H. Richards with A. G. Woodman: Water, Air, and Food from a Sanitary Standpoint.

Ellen H. Richards: University Laboratories in Relation to the Investigation of Public Health Problems and to Commercial Work. Transactions of the American Public Health Association, Vol. XXV.

S. P. Mulliken with H. Scudder: The Detection of Methyl Alcohol in Mixtures. American Chemical Journal, Vol. XXIV., p. 444.

J. F. Norris with H. Fay and D. W. Edgerly: The Preparation of Pure Tellurium. American Chemical Journal, Vol. XXIII., p. 105.

J. F. Norris with H. Fay: The Reduction of Selenium Dioxide by Sodium Thiosulphate. American Chemical Journal, Vol. XXIII., p. 119.

J. F. Norris with R. Mommers: The Isomorphism of Selenium and Tellurium. American Chemical Journal, Vol. XXIII., p. 486.

F. J. Moore: Ueber Abspaltung einer Sulfogruppe durch reducirende Agentien. Berichte der Deutschen Chemischen Gesellschaft, XXXIII., p. 2014.

H. Fay with S. Badlam: Heat Treatment and Micro-Structure of Low Carbon Steels. Technology Quarterly, December, 1900.

Courses VI. and VIII. Electrical Engineering and Physics.

C. R. Cross: Historical Notes Relating to Musical Pitch in the United States. Proceedings of the American Academy of Arts and Sciences, Vol. XXXV., No. 22, 1900.

W. L. Puffer: Report on "Grounding of the Neutral" to Underwriters' National Electric Association, 1900.

W. L. Puffer: Notes on Dynamo Testing. Third Revised Edition. Printed for use of students in the Institute.

H. E. Clifford: Notes on Heat. Printed for use of students in the Institute.

F. A. Laws: An Apparatus for Recording Alternating Current Waves. Proceedings of the American Academy of Arts and Sciences, Vol. XXXVI., No. 17, 1901.

H. M. Goodwin with F. W. Grover: The Effect of Temperature, of Colloidal Ferric Hydrate, and of a Magnetic Field on the Hydrolysis of Ferric Chloride. Physical Review, Vol. II., p. 193, 1900; and Technology Quarterly, Vol. XIII., p. 327, December, 1900.

W. L. Smith: A Study of Certain Shades and Globes for Electric Lights, Part 1. Technology Quarterly, Vol. XIII., p. 3, September, 1900.

L. Derr: Tests on Railroad Signal Glass. Proceedings of the New England Railroad Club, May, 1900.

L. Derr: Automobile Vehicles. Journal of the Association of Engineering Societies, July, 1900.

C. L. Norton: Tests of Fire Retardent Materials. Technology Quarterly, Vol. XIII., p. 1, June, 1900.

C. L. Norton: The Diffusion of Light through Windows. Report to Associated Factory Mutual Companies of New England. October, 1900.

J. G. Coffin: The Reflection of Light in the Neighborhood of the Critical Angle. Technology Quarterly, Vol. XIII., p. 2, June, 1900.

Course VII. Biology.

T. Hough: Review of Swedish Gymnastics. Boston. George H. Ellis, Printer. Reprinted in Report of United States Commissioner of Education, 1898–1899.

T. Hough: The Physiological Significance of the Flow of

Lymph and its Relation to Muscular Exercise. American Physical Education Review, Vol. V., No. 2, 1900.

T. Hough: Ergographic Experiments upon Muscular Fatigue and Soreness. Journal of the Boston Society of Medical Sciences, Vol. V., November, 1900.

R. P. Bigelow: A Study of Heredity among the Deaf. (Review of "Marriages of the Deaf in America," by E. A. Fay.) American Naturalist, Vol. XXXIV., No. 398, February, 1900.

R. P. Bigelow: Articles "Allantois," "Area Embryonalis," and "Biology," Wood's Reference Handbook of the Medical Sciences, Vol. I., 1900.

R. P. Bigelow: The Anatomy and Development of Cassiopea xamachana. Memoirs of the Boston Society of Natural History, Vol. V., N 5, August, 1900.

Course IX. General Studies.

W. Z. Ripley: Capitalization of Public Service Corporations. Quarterly Journal of Economics, November, 1900.

Course XII. Geology.

W. O. Crosby: Geological History of the Nashua Valley during the Tertiary and Quaternary Periods. Technology Quarterly, December, 1899.

W. O. Crosby: Report on the Borings for the East Boston Tunnel. Appendix to Annual Report of the Boston Transit Commission, 1899.

W. O. Crosby: Outline of the Geology of Long Island in its Relation to the Public Water Supplies. Technology Quarterly, June, 1900.

W. O. Crosby: Notes on the Geology of the Sites of the Proposed Dams in the Valleys of the Housatonic and Ten Mile Rivers. Freeman's Report on New York's Water Supply, and Technology Quarterly, June, 1900.

W. O. Crosby: The Origin of Phenocrysts and the Devel-

opment of the Porphyritic Texture in Igneous Rocks. The American Geologist, May, 1900.

W. O. Crosby: The Blue Hills Complex. Occasional Papers of the Boston Society of Natural History, Vol. IV., Part 3.

G. H. Barton: Outline of Elementary Lithology.

M. L. Fuller: The Occurrence and Uses of Mica. Stone, Vol. XIX., No. 6, November, 1899.

M. L. Fuller: An Instance of Sub-Aqueous Differential Weathering. American Geologist, Vol. XXV., No. 6, June, 1900.

Department of Mathematics.

D. F. Bartlett: General Principles of the Method of Least Squares, with Applications. Second Edition.

F. S. Woods: Review of Lobachevsky's Geometry. Bulletin of the American Mathematical Society, May and July, 1900.

STATISTICS.

The Corps of Instructors.

The catalogue of this year shows the number of instructors of all grades to be 139, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 181. This year's catalogue will show an increase of five in the number of lecturers and some changes in the grades of professors and instructors. Reference has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and two-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1899–1900.	1900–1901.
Professors	24	25
Associate Professors	9	11
Assistant Professors	21	27
Instructors	46	44
Assistants	35	32
Lecturers	37	42
Total	172	181

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,277. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1883–84	443
1866–67	137	1884–85	579
1867–68	167	1885–86	609
1868–69	172	1886–87	637
1869–70	206	1887–88	720
1870–71	224	1888–89	827
1871–72	261	1889–90	909
1872–73	348	1890–91	937
1873–74	276	1891–92	1,011
1874–75	248	1892–93	1,060
1875–76	255	1893–94	1,157
1876–77	215	1894–95	1,183
1877–78	194	1895–96	1,187
1878–79	188	1896–97	1,198
1879–80	203	1897–98	1,198
1880–81	253	1898–99	1,171
1881–82	302	1899–1900	1,178
1882–83	368	1900–1901	1,277

Students by Classes.

The aggregate number of students for 1900–1901 is divided among the several classes as follows:

Fellows	7
Graduate students, candidates for advanced degrees	5
Regular students, Fourth Year	193
" " Third "	184
" " Second "	205
" " First "	340
Special students	345
Total	1,279
Counted twice	2
	1,277

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	10	...	10
Fourth Year	193	80	273
Third Year	184	110	294
Second Year	205	121	326
First Year	340	34	374
Total	932	345	1,277

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	37	35	16	20	20	27	1	2	5	15	4	1	11	193
3d " "	20	45	18	19	14	31	5	1	2	9	8	...	12	184
2d " "	32	47	35	14	16	29	...	1	1	10	5	....	15	205
Total . . .	89	127	69	53	50	87	6	4	8	34	17	1	38	582*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1890 . . .	79	95	18	27	27	105	11	4	13	18	7	3	...	407
1891 . . .	81	104	17	33	23	108	11	5	19	28	9	3	...	441
1892 . . .	76	106	9	37	35	112	9	5	16	34	5	3	...	457
1893 . . .	78	97	22	50	39	141	4	10	19	37	10	2	8	511
1894 . . .	88	111	19	48	50	137	5	9	19	35	13	1	20	556*
1895 . . .	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896 . . .	99	117	24	65	61	106	7	11	11	34	8	...	25	573
1897 . . .	109	119	38	...	60	90	8	9	10	36	7	1	26	578*
1898 . . .	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899 . . .	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900 . . .	89	127	69	53	50	87	6	4	8	34	17	1	38	582*

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	3	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . . .	2	..	1	..	..	..	1	..	..	..	..	..	..	..
3d . . .	9	2	2	2	..	1	1	..	..	..	..	..	..	1
4th . . .	17	4	4	3	..	..	3	..		1	1	1	..	..
5th . . .	4	1	1	1	..	..	1	..	..	..	..	..	..	..
	35	7	8	6	..	1	6	..	..	1	1	1	..	1

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . . .	89	Language	144
Architecture	40	Mathematics	166
Biology	39	Mechanical Engineering . .	106
Chemistry	111	Mining Engineering . . .	18
Civil Engineering	57	Naval Architecture	13
Drawing	135	Physics	207
Electrical Engineering . .	25	Political Science	75
English	105	Sanitary Engineering . . .	1
Geology	47	Shopwork	83
History	83		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . .	376	288	143	37	844
Chemistry . . .	389	67	66	71	593
English	336	272	22	8	638
French	151	88	49	...	288
Physics	...	319	293	181	793
German	83	195	151	1	430
Shopwork . . .	19	144	54	78	295

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	1	1
Arkansas	..	..	..	..	1	1	..	1
California	..	1	..	1	2	4	6	10
Colorado	..	..	2	1	1	4	4	8
Connecticut	..	6	6	4	10	26	9	35
Delaware	..	2	..	..	..	2	2	4
Dist. of Columbia	..	1	2	2	6	11	2	13
Florida	..	..	..	..	1	1	0	1
Georgia	..	..	..	1	1	2	1	3
Hawaiian Islands	..	1	..	..	..	1	..	1
Illinois	..	8	7	6	7	28	11	39
Indiana	..	..	..	4	..	4	3	7
Iowa	1	1	1	..	4	7	3	10
Kentucky	..	2	..	2	..	4	1	5
Louisiana	..	1	..	..	..	1	1	2
Maine	..	1	3	5	7	16	6	22
Maryland	..	1	..	2	6	9	4	13
Massachusetts	9	119	114	123	223	588	191	779
Michigan	..	1	2	2	1	6	2	8
Minnesota	..	3	2	1	1	7	..	7
Missouri	..	1	1	1	4	7	6	13
Montana	..	..	..	1	2	3	2	5
Nebraska	..	..	..	..	2	2	2	4
Nevada	..	1	..	..	..	1	..	1
New Hampshire	..	4	2	9	3	18	8	26
New Jersey	..	1	3	1	2	7	1	8
New York	..	13	9	7	23	52	16	68
North Carolina	..	..	..	..	..	..	2	2
Ohio	..	7	..	5	7	19	8	27
Oregon	..	..	..	..	..	..	1	1
Pennsylvania	..	5	6	9	7	27	10	37
Rhode Island	..	3	5	8	6	22	13	35
South Carolina	..	..	..	1	..	1	..	1
South Dakota	..	..	..	1	..	1	..	1
Tennessee	..	..	..	1	..	1	5	6
Texas	..	..	..	1	1	2	2	4
Utah	..	1	2	1	2	6	1	7
Vermont	..	2	5	..	2	9	6	15
Virginia	..	..	1	1	..	2	1	3
Washington	..	..	..	1	1	2	..	2
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	3	1	1	6	2	8
Foreign Countries.								
Bermuda	..	..	..	..	..	..	1	1
Denmark	..	1	..	..	..	1	..	1
England	..	1	1	..	1	3	..	3
France	..	..	2	1	1	4	..	4
Germany	..	..	1	..	1	2	..	2
Jamaica	..	..	..	..	..	..	1	1
Japan	..	..	..	..	..	..	2	2
Mexico	..	2	1	..	1	4	3	7
New Brunswick	..	1	1	..	..	2	..	2
Nova Scotia	..	..	..	1	1	2	..	2
Quebec	..	1	..	..	1	2	2	4
Russia	..	..	..	..	..	..	1	1
Turkey	..	..	2	..	..	2	1	3
Total	10	193	184	205	340	932	345	1277

Forty States of the Union, besides the District of Columbia and Hawaiian Islands, are represented on our list of students. Of the total number of 1,277, 779 are from Massachusetts, or 60.9 per cent. of the whole; 133 are from other New Eng-

land States; 366 are from outside New England. Of these, 33 are from foreign countries.

A table showing the number of students in each year, from 1894, coming from each State or Territory, and from each foreign country, may be not without interest and instruction:

	1894.	1895.	1896.	1897.	1898.	1899.	1900.		1894.	1895.	1896.	1897.	1898.	1899.	1900.
States.								*States.*							
Alabama	1	..	1	1	1	..	1	Washington	3	1	5	4	7	4	2
Arkansas	..	..	1	1	..	..	1	West Virginia	1	3	2	1	..	1	1
California	9	8	9	9	11	9	10	Wisconsin	6	7	6	6	8	7	8
Colorado	8	7	7	8	8	7	8	Wyoming	..	..	1	..	..	..	..
Connecticut	29	27	24	30	26	29	35	*Foreign Countries.*							
Delaware	4	5	5	6	3	4	4								
Dist. of Columbia	12	16	17	13	8	7	13								
Florida	2	1	..	1	..	1	1	Belgium	1	..	..	..	..	..	..
Georgia	2	2	3	4	4	3	3	Bermuda	..	..	..	..	..	..	1
Hawaiian Islands	..	..	..	..	1	..	1	Brazil	1	1	..	..	..	..	..
Idaho	..	1	1	1	..	..	..	Bulgaria	..	..	..	..	..	..	..
Illinois	36	42	45	40	51	36	39	Cape Breton	..	..	..	..	1	..	..
Indiana	3	2	3	7	3	5	7	Central America	..	1	..	..	..	..	..
Iowa	10	12	14	12	7	6	10	Chile	1	1	1	..	..	..	..
Kansas	4	4	3	3	..	..	..	Columbia	..	..	..	..	..	..	..
Kentucky	12	11	12	10	10	4	5	Cuba	1	3	2	1	1	..	..
Louisiana	3	2	..	1	1	1	2	Denmark	..	..	..	2	1	1	1
Maine	38	38	27	24	19	25	22	Dutch Guiana	..	..	..	..	1	1	..
Maryland	4	9	9	8	8	8	13	England	..	2	2	2	4	1	3
Massachusetts	708	721	730	739	719	731	779	France	..	..	1	1	1	2	4
Michigan	8	7	6	5	9	10	8	Germany	1	..	..	..	1	1	2
Minnesota	10	5	7	8	11	10	7	Guatemala	..	..	..	.	..	..	..
Missouri	14	9	11	6	10	11	13	Holland	2	..	..	..	..	..	..
Montana	2	1	3	5	2	3	5	Ireland	1	..	.	..	..	.	..
Nebraska	4	2	2	2	1	3	4	Jamaica	..	..	..	..	..	1	1
Nevada	2	..	..	..	..	1	1	Japan	1	2	2	..	1	2	2
New Hampshire	28	30	26	25	25	29	26	Mexico	1	1	3	6	7	7	7
New Jersey	5	5	13	15	13	12	8	New Brunswick	1	1	2	2	3	3	2
New Mexico	1	1	..	..	..	..	..	New South Wales	1	1	..	..	..	..	..
New York	59	64	69	62	68	61	68	Nova Scotia	1	2	1	1	2	..	2
North Carolina	..	..	1	1	2	2	2	Ontario	4	2	2	..	..	..	..
Ohio	50	37	28	30	23	27	27	Peru	..	..	..	..	..	..	..
Oregon	1	1	4	3	3	2	1	Porto Rico	1	1	..	..	..	..	..
Pennsylvania	37	36	42	41	34	33	37	Quebec	2	2	2	2	1	3	4
Rhode Island	26	21	20	19	23	32	35	Russia	..	..	..	..	..	1	1
South Carolina	3	5	6	4	1	1	1	Scotland	1	..	..	..	..	..	..
South Dakota	..	..	..	..	..	1	1	Spain	1	1	..	..	..	..	..
Tennessee	1	1	1	3	3	4	6	Trinidad	..	..	..	..	..	..	..
Texas	6	3	2	2	1	2	4	Turkey	1	3	1	3	3	3	3
Utah	2	5	2	3	5	6	7	Venezuela	1	1	1	..	..	..	..
Vermont	3	5	7	11	12	12	15								
Virginia	2	5	3	4	3	2	3	Total	1183	1187	1198	1198	1171	1178	1277

Residence of Massachusetts Students.

It has been said that 60.9 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and thirty-four cities and towns are on the lists. The first column of

the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-four and Suffolk two hundred and twenty pupils; Essex comes third, with one hundred and ten; Norfolk fourth, with seventy-four.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	5	Middlesex	36	244
Berkshire	3	4	Nantucket	1	1
Bristol	8	19	Norfolk	17	74
Essex	22	110	Plymouth	13	38
Franklin	4	7	Suffolk	4	220
Hampden	6	25	Worcester	15	30
Hampshire	2	2			
			Total	135	779

The following is a list of the towns, forty-two in number, which send four or more students to the Institute:

Boston	200	Salem	11	Haverhill	5
Newton	51	Gloucester	11	Holyoke	5
Cambridge	39	Hyde Park	9	Marlboro	5
Newburyport	25	Malden	9	Medford	5
Lowell	23	Waltham	9	Taunton	5
Brookline	19	Fitchburg	7	Canton	4
Somerville	18	Natick	7	Dedham	4
Lawrence	17	Quincy	7	Framingham	4
Chelsea	16	Wellesley	7	Peabody	4
Springfield	16	Winchester	7	Plymouth	4
Brockton	14	Andover	6	Stoughton	4
Lynn	13	Everett	6	Wakefield	4
Arlington	12	Middleboro	6	Woburn	4
Melrose	11	Milton	6	Worcester	4

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear

first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and twenty-eight persons of unusual ages. These deductions leave three hundred and nine as the number of students whose ages have been made the subject of computation.

Period of Life.	1899–1900.		1900–1901.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	2	..	1	...
16½ to 17 "	3	5	4	5
17 to 17½ "	16	..	10	..
17½ to 18 "	32	48	41	51
18 to 18½ "	57	..	53	..
18½ to 19 "	52	109	65	118
19 to 19½ "	34	..	55	..
19½ to 20 "	40	74	30	85
20 to 20½ "	28	..	25	..
20½ to 21 "	11	39	18	43
21 to 22 "	8	8	7	7
	283	283	309	309

The results appear in the table above in comparison with the corresponding results of 1899–1900.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and seventy-eight members of the class were distributed among the different periods of life as follows:

Under 20½	3
Between 20½ and 21	8
" 21 " 21½	16
" 21½ " 22	25
" 22 " 23	57
" 23 " 24	31
" 24 and over	38
Total	178

The special students this year constitute twenty-seven per cent. of the whole body, as against twenty-six per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is ninety-eight. Of these seven are our own graduates, five being candidates for advanced degrees.

Ninety-one are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Twenty-two are graduates of Harvard University; three each of Amherst and Yale Colleges, and five of Brown University; two each of McGill and Vermont Universities, Davidson, Grove City, Neuchâtel, Mt. Holyoke, Southwestern, Presbyterian Colleges, and Worcester Polytechnic Institute; one each of Alabama, California, Chicago, Columbia, Denison, Japan, Lehigh, Leland Stanford Jr., Michigan, Nebraska, New York, Ohio State, Princeton, University of the South, Syracuse, Virginia, and Washington Universities; one each of Acadia,

Augustana, Bates, Beloit, Boston, Bowdoin, Bryn Mawr, Delaware, DePauw, Gallaudet, Monmouth, Randolph, Macon, Robert, St. Joseph, St. Xavier's, Smith, South Kentucky, Villanova, Washington and Lee, and Williams Colleges; one each of Harvard Medical School, and Virginia Military Institute.

Women as Students at the Institute.

The number of women pursuing courses with us is forty-four. Of these, four are graduates of colleges. Of the total number, three are regular students of the fourth year; four of the third year; six of the second year; eight of the first year. Twenty-three are special students. Of the thirteen regular students of the upper classes, four take Course IV., Architecture; two, Course V., Chemistry; three, Course VII., Biology; three, Course VIII., Physics; one, Course IX., General Studies. Of the special students, fourteen devote themselves to Biology, four to Chemistry, one to General Studies, one to Physics, one to Naval Architecture, and one to Geology.

Statistics of Examinations.

Of the 1,277 students of the present year, 788 were not connected with the school in 1899–1900. Of these, 310 were admitted as regular students of the first year upon the basis of their entrance examinations. The 177 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 310 who were thus admitted to the first year on examination, and have taken their place in the school, 104 were admitted on examination, but have not entered the school.

In the case of the 310 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	237
" on one condition	51
" on two conditions	18
" on more than two conditions	4
	310

Sixty-one applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Belmont, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Exeter (N.H.), Kansas City (Mo.), Louisville, Manlius (N.Y.), Newport, New York, Philadelphia, Pittsburgh, Portland (Me.), Pottstown, Poughkeepsie, St. Louis, Springfield (Mass.), and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	.	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	28	3	5	13	..	18	3	2	6	..	..	..	..	103
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	.	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1396	25	34	10	24	17	..	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	..	33	3	4	6	9	3	..	7	200
1899	30	38	9	22	21	..	32	2	2	1	9	1	..	8	173*
1900	31	33	20	21	16	..	22	3	3	5	11	4	..	9	183†
Totals	436	521	188	197	260	1	406	39	35	79	90	29	8	43	2,332
Deduct names counted twice															12
Net total															2,320

* Deducting names counted twice.
† Including seven persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 11, 1899, to May 10, 1900.

The first meeting of the Society of Arts for the present year was held on Oct. 12, 1899. Fourteen meetings have been held, the average attendance being ninety persons. The following papers have been read: "Some Practical Applications of Storage Batteries," by Mr. J. S. Woodbridge; "Visual Signals," by Mr. H. C. Spaulding; "Use of Kites to Obtain Meteorological Data," by Prof. A. Lawrence Rotch; "New Cellulose Industries," by Mr. A. D. Little; "Exhibition of Building Stones and Minerals collected by the Geological Department of the Massachusetts Institute of Technology in Association with the Commissioners of Massachusetts and the United States for the Paris Exposition," by Professors Niles, Crosby, and Mr. Fuller; "The Character and Extent of Food and Drug Adulterations in Massachusetts, and the Systems of Inspection of the State Board of Health," by Mr. Albert E. Leach; "A New Dynamo-Static Machine," by Prof. Elihu Thomson; "An Architect's Tour through the Riviera and Central France," by Prof. E. B. Homer; "Massachusetts Roads, Old and New," by Mr. William E. McClintock; "Water Storage on the Gila River, Arizona," by Mr. F. H. Newell; "The Boston Elevated Railway System," by Gen. W. A. Bancroft; "Recent Changes of Opinion in England in Favor of the Bacterial Purification of Sewage," by Prof. L. P. Kinnicutt; "Lecture Room Models for illustrating the Modern Methods for Electric Transmission

of Power," by Prof. W. L. Puffer; "Steel, Gray, and Gun Iron Castings; Their Uses and Relative Values," by Prof. W. W. Bird.

At the first meeting of the year the resignation of the Secretary, Mr. Arthur T. Hopkins, was accepted, and Dr. Wendell elected to the position.

During the year there have been a number of changes in membership. Mr. William Jackson, City Engineer of Boston, has been elected to Life Membership, making the number of such members 47; of the Associate Members, 2 have died, 8 have resigned; 22 new members have, however, been elected, making the present membership 339.

In the death of Professor Silas W. Holman the Society lost one of its most distinguished members, and the Institute of Technology one of its most eminent teachers. While his health lasted he evinced a most active interest in the welfare of the Society, as its Secretary from 1881 to 1883, and by his many contributions to the "Quarterly." A sketch of his life will be found in the "Technology Review" for July, 1900.

The publication of the "Technology Quarterly" has been continued under the same management as last year. Since the last annual report, twenty papers have been published in the "Quarterly," of which six were read before the Society, the rest being presented only by title. Besides these, the Proceedings of the Society, and the Review of American Chemical Research, contributed by members of the Chemical Department, have appeared in each number. Mr. Axson's article on "Nitrates as a Product of Combustion" is the first of a new series of contributions from the Laboratory of Sanitary Chemistry. Two of the articles embody the results of notable pieces of work done by members of the Faculty. One, on the "Geological History of the Nashua Valley during the Tertiary and Quaternary Periods," by Professor W. O. Crosby, gives the scientific results of an extended investigation carried on under the auspices of the Metropolitan Water Commission. The other is by Professor Hofman on "The

Temperatures at which Certain Ferrous and Calcic Silicates are formed in Fusion, and the Effect upon these Temperatures of the Presence of Certain Metallic Oxides," a subject of great practical importance in metallurgy. The research was carried on under a grant from the C. M. Warren Fund of the American Academy of Arts and Sciences.

At the last meeting of the year, the thirty-eighth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, and Charles T. Main were reëlected members of the Executive Committee, and Mr. G. V. Wendell was reëlected Secretary for the year 1900–1901. Mr. James P. Munroe was elected to serve on the Executive Committee in place of Mr. Frank W. Hodgdon, resigned.

Respectfully submitted,

GEORGE V. WENDELL,

Secretary.

DECEMBER 1, 1900.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 29, 1900.

Under the will of the late Robert C. Billings the Institute received $92,500 free from all conditions. The sum bequeathed was $100,000, but the succession tax reduced it to the above amount.

It will be remembered that in the last report acknowledgment was made of a gift of $50,000 from Augustus Lowell, Esquire, to constitute "The Teachers' Fund." Since Mr. Lowell's death, his executors have, in conformity with his wishes, added $50,000 more to the previous gift. This wise and generous bequest is an added proof of Mr. Lowell's great interest in the Institute, an interest to which it is most deeply indebted not only for generous financial aid, but for constant care and devotion in watching its interests, and helping to guide its development.

There has also been received from the estate of Henry L. Pierce the sum of $15,000, from the Trustees of the J. W. and Belinda Randall Charity $8,452.36, from the estate of Mrs. Julia B. H. James $17,154.21, and from that of Miss Susan E. Dorr $2,061.55, all of which sums are in addition to large amounts previously received from the same sources. Besides these sums a gift of $500 came from a friend of the Institute, and Francis Blake, Esquire, kindly contributed $100 toward the cost of a telescope.

One transaction of very especial importance to the future of the Institute has been completed during the past year, viz., the purchase of some fifty-two thousand feet of land bounded by Trinity place, Stanhope street, and Clarendon street extended and immediately adjoining other land owned by the Institute on Clarendon street and Trinity place. The change in the location of the Boston & Providence Railroad tracks offered this opportunity, and it is believed that the purchase is a very wise one in view of the future needs of the Institute. The immediate result, however, of sinking so large a sum of money in unproductive real estate is to diminish our annual income, and we start the new year with a smaller amount of interest-bearing property than we had a year ago. The total amount, however, of the Institute property, both real and personal, has been increased during the year by a net amount of $219,853.07, after deducting the sum of $8,593.54, which is the excess of expenses over income. In addition to the gifts above referred to, there has been a profit on securities sold during the year of $40,446.51.

In the items of salaries and department supplies there has been a decided increase during the year, but the charges for repairs and general expenses are much smaller than in the previous year. It will be noted that the annual deficit in current expense account is more than $11,000 less than in 1899.

While the Institute's property has of late years increased rapidly, it must be borne in mind that a very large proportion of its funds are held for scholarship or kindred purposes, so that of the total income from securities and rents more than one-quarter is so used. In addition to this there are twenty free State scholarships and twenty more for which the State has paid annually $4,000.

SECURITIES SOLD OR PAID, W. B. ROGERS MEMORAL FUND.

$2,000	Ottawa, Oswego & Fox River R R. 8s	1900	2,000.00

RECEIVED.

$3,000	Chi., Mil. & St. Paul R.R. 7s. transferred from General Funds	1905	3,613.18

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

$1,000	Bur. & Mo. River (Neb.) R.R. 6s., non-ex.	1918	1,000.00
1,000	Chi., Burlington & Quincy R.R. 4s.	1922	1,000.00
3,000	Chi., Mil. & St. Paul R.R. 7s. transferred to Rogers Fund	1905	3,613.18
4,000	Chi., Bur. & Northern R.R. 5s.	1926	4,200.00
31,000	Walter Baker Co. Lt'd. 4½s.	1903	31,000.00
250,000	New York Revenue 3½s.	1899	250,000.00
26 Sh.	Boston & Albany R.R.		6,226.50
194 "	Morris & Essex R.R.		17,945.00
40 "	New York & Harlem R.R.		8,060.00
85 "	Pittsburgh, Fort Wayne & C. R.R.		15,895.00
100 "	N. Y., New Haven & Hartford R.R.		21,211.25
50 "	Boston & Maine R.R., common		9,750.00
25 "	Boston & Providence R.R.		7,490.00
50 "	Fitchburg R.R., Pf.		6,100.00
90 "	Pullman's Palace Car Co.		17,010.00
59 "	Everett Mills		5,815.00
6 "	Manchester Mills		600.00
1 "	Merrimack Manf. Co.		1,150.00
158 "	Pennsylvania Coal Co.		32,390.00
40 "	Cambridge Gas Light Co.		9,600.00
10 "	National Union Bank		1,358.75
5 "	First Nat. Bank of Baltimore		825.00
50 "	American Bell Telephone Co.		15,600.00
55 "	New England Tel. & Tel. Co.		7,475.00
40 Rights	The Molsons Bank, Montreal		70.00
			$475,384.68

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$25,000	Chi. Terminal & Transfer Co. 1st 4s.	1947	24,520.00
95,000	Illinois Steel Co. Non-conv. 5s.	1913	95,296.25
50,000	Long Island R.R. 4s.	1949	46,637.50
7,000	K. C., Clinton and Springfield R.R. 5s.	1925	6,289.21
8,500	K.C., Mem. & Birmingham R.R. 4s.	1934	8,287.50
13,000	K. C., St. Jo. & Council Bluffs R.R, 7s.	1907	15,210.00
50,000	Kansas City Stock Yards 5s.	1910	57,664.90
25,000	Atchison, Top. & St. Fé R.R. 4s.	1995	25,281.25
50,000	Rio Grande & Western R.R. 4s.	1939	49,180 00
50,000	Oregon R.R. & Navigation Co. 4s.	1946	51,375.00
50,000	Union Pacific R.R. 4s.	1947	52,000.00
100,000	Chi. & West Michigan R.R. 5s.	1921	102,205.00
100,000	American Tel. & Tel. Co. 4s.	1929	99,875.00
50,000	New England Tel & Tel. Co. 4s.	1930	50,625.00
50,000	Chi. Junc. & Union Stock Yards 4s.	1940	49,250.00
			$733,696.61

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS
Dr.

Cash balance, Sept. 30, 1899		61,746.50
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500.00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,304.00	
" " " " scholarships (students' fees)	7,775.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	525.00	
" " " " Library	480.00	
" " " " general purposes	14,876.18	
" " Rogers Memorial Fund	10,900.48	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	8,215.00	
" " " " " Awards	4,169.36	
" " Teachers' Fund "	1,000.00	
Letter Box Fund [1899, 31.00]	125.00	
Students' fees	200,744.93	
State Scholarships	4,000.00	
United States Act of 1862	2,188.59	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	10,829.84	
Rents, per Table (page 68)	12,575.10	
Gifts	600.00	
Interest	22,882.78	
Boston University	1,150 00	
Sale printed Lecture Notes	2,562.72	
		347,132.47
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	785.57	
" Teachers' Fund [add'l 50,000.00]	51,000.00	
" Edward Austin Fund	1,215.64	
" Susan E. Dorr Fund [add'l 2,061.55]	2,388.32	
		55,389.53
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	15,000.00	
James Fund, additional	17,154.21	
J. W. and Belinda Randall Fund, additional,	8,452 36	
Robert C. Billings Legacy	92,500.00	
		133,106.57
SECURITIES SOLD OR PAID. GENERAL FUND, page 59.		475,384.68
" " " Rogers Memorial Fund		2,000.00
SUNDRIES.		
Income credited to Bond Premium Acct.	3,356.15	
Income credited to Rogers Bond Premium Acct.	712.52	
Boston Art Students' Association, on acc't	666.67	
Students' Notes paid and charged off	415.00	
Notes Receivable	316,500.00	
		321,650.34
		$1,405,410.09

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 29, 1900.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 68)	249,072.05	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	4,169.36	
Teachers' Fund	1,000.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 69)	12,406.00	
General Expenses, per Table (page 69)	16,707.40	
Fire Insurance	2,338.61	
Fuel	7,339.11	
Water	2,161.90	
Gas	2,187.65	
Electricity	1,627.55	
Printing and Advertising	3,987.28	
" Lecture Notes	4,626.85	
" Annual Catalogues and Reports	2,434.93	
Rents paid Boston & Albany R R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 68)	41,487.55	
Society of Arts	127.84	
Interest paid A. Lowell, Trustee	1,000.00	
Paris Exposition	971.93	
		355,726.01
[Expenses more than Income, $8,593.54]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 59)		733,696.61
Rogers Memorial Fund		3,613.18
Henry L. Pierce Building, Trinity Place, on acct.		1,421.59
Boiler and Power House, Trinity Place, on acct.		4,575.00
Lot No. 3 Trinity Place		259,050.00
SUNDRIES.		
Letter-Box 1899, used	31.00	
Students' Notes charged off	365.00	
" deposits paid	100.00	
		496.00
Cash balance, Sept. 29, 1900		37,831.70
		$1,405,410.09

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 29, 1900:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
3,800.00	Republican Valley R.R. 6s. . . .	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R.6s.	1920	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R.7s.	1908	2,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00	
3,000.00	Chi., Mil. & St. Paul R.R. 7s. . .	1905	3,000.00	
	Advances to Bond Premium account.		10,842.50	
	Bonds			250,225.00

INVESTMENTS, GENERAL ACCOUNT.

$10,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	10,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R.4s.	1922	4,100.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R.7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00	
6,000.00	West End Street Ry. 5s	1902	6,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
8,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	8,000.00	
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00	
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00	
90,000.00	Walter Baker Co. Ltd. 4½s . . .	1903	90,000.00	
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50	
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00	
50,000.00	Chi. Junc. & Union S. Yards inc. 5s.	1907	50,000.00	
50,000.00	Long Island R.R. 4s.	1949	46,637.50	
7,000.00	K.C., Clinton & Springfield R.R. 5s.	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s. . . .	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s. .	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s. .	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00	
100,000.00	Chic. & West Michigan R.R. 5s. .	1921	100,000.00	
100,000.00	American Tel. & Tel. Co. 4s. . .	1929	99,875.00	
50,000.00	New England Tel. & Tel. Co. 4s. .	1930	50,000.00	
50,000.00	Chi. Junc. & Union Stock Yards 4s.	1940	49,250.00	
	Advances to Bond Premium account,		38,777.25	
	Bonds			1,335,490.21
	Amount carried up			$1,585,715.21

Amount brought up $1,585,715.21

STOCKS.

SHARES.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	
					157,014.84

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,761,853.75

Amount brought up		1,761,853.75
REAL ESTATE.		
Rogers Building	200,000.00	
Walker "	150,000.00	
Land on Garrison Street	50,840.00	
Workshops " "	30,000.00	
	80,840.00	
Land on Trinity Place	76,315.69	
Engineering B'ld'g A, Trinity Place,	90,000.00	
	166,315.69	
Gymnasium Building	7,967.85	
Engineering Building B	57,857.10	
Lot No. 2, Trinity Place	137,241.60	
Lot No. 3, Trinity Place	259,050.00	
Henry L. Pierce Building, Trinity Place	154,297.05	
Boiler and Power House, Trinity Place	26,916.74	
Clarendon St. Land and Building	142,762.94	
House No. 34 Commonwealth Ave.	30,000 00	
Real Estate, Massachusetts Ave., Cambridge	16,154.38	
		1,429,403.35
Equipment, Engineering Building	16,555.24	
" Workshops	20,628.56	
		37,183.80
SUNDRIES.		
Notes Receivable	62,000.00	
Boston Art Students' Association	10,333.32	
Students' Notes	835.50	
Cash Balance, Sept. 29, 1900	37,831.70	
		111,000.52
		$3,339,441.42

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	83,432.36	
James Fund	163,654.21	
		676,696.68
Amount carried up		$576,696.68

Amount brought up		676,696.68
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,238.21	
James Savage Fund	13,825.69	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,640.62	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,342.57	
Charles Lewis Flint Fund	5,264.09	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,815.67	
William F. Huntington Fund	5,216.66	
T. Sterry Hunt Fund	3,225.32	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,755.89	
Ann White Dickinson Fund	40,618.19	
Dalton Grad. Chem. Fund	5,983.21	
Willard B. Perkins Fund	6,576.13	
		252,808.90
OTHER TRUSTS.		
Charlotte Billings Richardson Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,297.64
Susan E. Dorr Fund		9,526.92
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin Fund		341,215.64
Teachers' Fund		101,000.00
Letter-box Fund, balance		51.12
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	200.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	795,000.00	
John W. Carter Legacy, 1898	6,250.00	
Robert C. Billings Legacy	92,500.00	
M. I. T. Stock Account	840,515.74	
		1,764,465.74
		$3,339,441.42

Comparative Statement of Funds, etc.

	Sept. 30, 1899.	Sept. 29, 1900.
Trusts for general purposes	631,090.11	676,696.68
" " Salaries	107,600.00	107,600.00
" " Scholarships	252,025.16	252,808.90
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,295.81	1,297.64
Susan E. Dorr Fund	7,138.60	9,526.92
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
John Foster Legacy	10,000.00	10,000.00
Henry L. Pierce Legacy	780,000.00	795,000.00
John W. Carter "	6,250.00	6,250.00
Robert C. Billings "		92,500.00
Edward Austin Fund	340,000.00	341,215.64
Teachers' Fund	50,000.00	101,000.00
Letter-box Fund	82.12	51.12
Students' Deposits	300.00	200.00
Notes Payable	20,000.00	20,000.00
M. I. T. Stock Account	809,027.77	840,515.74
	$3,119,588.35	$3,339,441.42
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 58)	55,389.53	
Gifts and Bequests for General Purposes. (See page 58)	133,106.57	
Net gain on Securities sold	40,446.51	
		228,942.61
Less Funds of 1899, used	31.00	
" Students' Deposits paid	100.00	
" Students' Notes charged off	365.00	
" Expenses more than Income	8,593.54	
		9,089.54
		$219,853.07

	Sept. 29, 1909.
	676,696.68
	107,600.00
	252,808.50
	7,000.00
	37,378.78
	1,297.64
	9,526.92
	5,000.00
	25,000.00
	5,200.00
	5,200.00
	10,000.00
	795,000.00
	6,250.00
	92,500.00
	341,215.64
	101,000.00
	51.13
	200.00
	20,000.00
	840,515.74
	3,339,441.42
	238,942.61
	9,089.54
	$219,853.07

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,304.00	From Dividends, Bank Stocks	1,108.35
" " Scholarships	8,175.00	" State Tax returned on Bank Stocks	251.85
" " " James Savage Fund	400.00	" Bonds	39,696.13
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	3,995.18
" " Teachers' Fund	2,000.00	" " Coal and Gas Stocks	786.54
" " Edward Austin Fund	13,600 00	" " Manufacturing Stocks	1,872.75
" " Rotch Prize Funds	400.00	" Telephone Stocks	573 02
" " Rotch Architectural Fund	1,600.00	" Real Estate Stocks	2,915.00
" " Library	480.00		
" " General Purposes	14,876.18		
" " Increase of Funds	1,112.34		
" " Advances to Bond Premiums	3,356.15		
	$51,198.82		$51,198.82

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,900.48	Received Income from Railroad Bonds	11,613.00
Credited to Advances Bond Premiums	712.52		
	$11,613.00		$11,613.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Land and Building, Clarendon St., on account		5,000.00	
34 Commonwealth Avenue	1,659.75		
Less Annuity under Will,	1,000.00		
" Tax, etc.	411.58		
	1,411.58		
		248.17	
Use of Rooms and Gymnasium		2,071.60	
		12,619.77	
Less Tax and Repairs, Cambridge, net		44.67	
			12,575 10

Department Supplies.

Chemistry	11,246.60	
Physics	6,624.20	
Mining	5,685.80	
Civil Engineering	2,963.52	
Mechanical Engineering	2,757.03	
Workshops	2,436.72	
Architecture	2,162.14	
Periodicals	1,912.34	
English	1,337.14	
Biology	1,101.89	
Applied Mechanics	995.48	
Naval Architecture	844.63	
Geology	843.19	
Modern Languages	227.03	
Mathematics	224.58	
Military	90.29	
Drawing	54 97	
		41,487.55

Salaries.

Instruction	198,838.30	
Administration	23,350.65	
Labor	26,883.10	
		249,072.05

General Expenses.

Electrical Wiring, Lamps, etc.	3,666.56	
Postage	2,512.55	
Paving Trinity Place	1,645.32	
Stationery and Office Supplies	1,170.80	
Janitors' Supplies	1,168.69	
Diplomas and Commissions	668.28	
Sprinklers, General Fire Extinguisher Co.	604.00	
Entrance Examinations	603.46	
Heating and Ventilating Engineering Buildings A and B	600.00	
Washing	585.02	
Sundries	568.35	
Express	541.94	
Engine Room Supplies:		
Oil	161.47	
Sundries	88.64	
Waste	68.19	
	318.30	
Ice	279.12	
Furniture	271.22	
Window Shades	227.75	
Examination Books	212.50	
Books, Supplies, etc., for General Library	205.76	
Removing Ashes	163.50	
Gymnasium	160 80	
Graduation Exercises	151.75	
Deposit Vaults	150.00	
Telephone Service	101.15	
Street Watering	86.80	
Glass	72.67	
Lowell School of Design	31.11	
		16,707.40

Repairs.

Department Improvements:		
Chemistry	1,016.76	
Workshops	628.50	
Civil Engineering	461.51	
Physical	442.33	
Naval Architecture	374.85	
Architecture	296.98	
Mechanical Engineering	233.86	
Mining	177.62	
Geology	133.37	
Biology	77.98	
English	59.03	
Applied Mechanics	48.38	
Drawing	28.25	
Modern Languages	22.04	
Mathematics	3.75	
	4,005.21	
Walker Building	2,635.20	
Engineering Building	1,460.56	
Rogers Building	1,379.76	
Sundries	1,254.16	
Steam Fitting	700.00	
Pierce Building	566.97	
Boiler and Power House	281.83	
Gymnasium	122.31	
		12,406.00

BOSTON, December 7, 1900.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 29, 1900, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
WILLIAM L. PUTNAM, } *Members of the Auditing Committee.*

BOSTON, December 7, 1900.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have carefully examined the accounts of the Treasurer for the year ending September 29, 1900, and find everything to be correct. Said examination included: (1) A verification of the sums received during the year from all sources, embracing the interest on all investments; the changes in the same; the interest from deposits in banks and trust companies; and the students' fees. (2) The verification of the list of students with the Secretary's record of the same. (3) The vouchers for all sums paid out, and also the weekly pay-roll. The bank balances are correct and the items of the Trial Balance agree with the Ledger Balances.

Very respectfully yours,

EDWIN A. STONE,
Accountant.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 11, 1901

BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1902

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Members of the Corporation.

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President.
HENRY S. PRITCHETT.

Secretary.
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

JOHN D. RUNKLE.	SAMUEL CABOT.
WILLIAM ENDICOTT.	FRANCIS BLAKE.
HOWARD A. CARSON.	CHARLES W. HUBBARD.
CHARLES J. PAINE.	THOMAS L. LIVERMORE.
CHARLES FAIRCHILD.	A. LAWRENCE ROTCH.
DAVID R. WHITNEY.	JOHN R. FREEMAN.
ALEXANDER S. WHEELER.	GEORGE A. GARDNER.
JAMES P. TOLMAN.	WILLIAM H. LINCOLN.
HOWARD STOCKTON.	J. B. SEWALL.
ELIOT C. CLARKE.	CHARLES L. LOVERING.
NATHANIEL THAYER.	A. LAWRENCE LOWELL.
CHARLES F. CHOATE.	JAMES P. MUNROE.
HIRAM F. MILLS.	WILLIAM L. PUTNAM.
PERCIVAL LOWELL.	CHARLES G. WELD.
ARTHUR T. LYMAN.	EBEN S. DRAPER.
CHARLES MERRIAM.	ROBERT S. PEABODY.
THORNTON K. LOTHROP	ELIHU THOMSON.
CHARLES C. JACKSON.	ELLIOT C. LEE.
SAMUEL M. FELTON.	JAMES P. STEARNS.
DESMOND FITZGERALD.	LUCIUS TUTTLE.

On the Part of the Commonwealth.

HIS EXCELLENCY HON. W. MURRAY CRANE, *Governor.*
HON. OLIVER W. HOLMES, *Chief Justice of the Supreme Court.*
HON. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT.
GEORGE WIGGLESWORTH. } *Ex Officiis.*
HOWARD STOCKTON. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
ALEXANDER S. WHEELER.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
ELIOT C. CLARKE. LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE. EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

THORNTON K. LOTHROP. JOHN R. FREEMAN.
ELIOT C. CLARKE. A. LAWRENCE ROTCH.
ROBERT S. PEABODY.

Department of Physics and Electrical Engineering.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. ELIHU THOMSON.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. CHARLES C. JACKSON.
J. B. SEWALL. A. LAWRENCE LOWELL.
JAMES P. MUNROE.

Department of Modern Languages.

J. B. SEWALL. FRANK A. HILL.
THORNTON K. LOTHROP.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Biology.

SAMUEL CABOT. ELIHU THOMSON.
FRANCIS BLAKE. DESMOND FITZGERALD.

Department of Chemical Engineering.

ARTHUR T. LYMAN. SAMUEL CABOT.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELLIOT C. LEE.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

PRESIDENT'S REPORT.

To the Members of the Corporation:

In the report which follows I have endeavored to call to your attention the more interesting events in the progress of the Institute during the past year. This account, though a brief one, will make evident the fact that real progress is making. Not only has the attention of administrative officers and of the Faculty of the Institute been given to the task of promoting additional means of instruction, but the methods of instruction and the subjects taught are being inquired into as well. It is a useful experience for an institution of learning, as it is for an individual, to pause now and then, in order to examine its own work and to ascertain whether or not the best results attainable are being reached. Some such general inquiry is being made at this time by the Faculty and instructing staff; and while out of this discussion, perhaps, no sudden change is likely to come, it is possible that a better perspective of the work itself and of the relations of instructors and students to that work may result.

In this examination it has not been forgotten that the Institute aims to educate its students as well as to train them, and that, to be a successful engineer in the best sense, a man needs to be educated as well as trained. President Rogers had clearly in mind this dual purpose of the Institute,—education and training. In the earlier catalogues he stated its aims in the following words:—

"The course is so selected and arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for the professions

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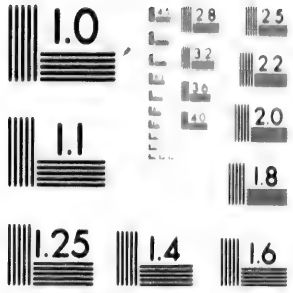

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NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

24:1

of Civil and Mechanical Engineering, etc. It is intended to secure to every student, whatever his special course of study, a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object."

More than thirty years have gone by since those words were written, but the ideal there set forth is that which the Institute stands for to-day; and I should be glad to have the members of the Corporation know that, notwithstanding the many demands which engineering makes upon institutions of learning, time and thought are being given so to adapt our instruction to these ever-increasing needs as not to lose sight of the Institute's duty to educate as well as to train.

Any such internal examination of the working of the Institute brings to light urgent needs, and shows opportunities for wider usefulness; but there are two plans already definitely set on foot which mean so much to the success of the work itself, and which are so absolutely necessary for the present wants of the Institute, that I ask your immediate consideration of them, and, through you, the consideration and generous help of those who are interested in the education of earnest young men, whether they be residents of this city or region or not. The Institute of Technology is not a local institution. It has served, and will continue to serve, the interests of the entire country.

The first plan to which I refer is one for enabling the Institute not only to keep its facilities for instruction abreast of the modern demands in such subjects as physics, electricity, chemistry, and the like, but to keep up its standards of instruction in the face of the increasing demands created by the large accession to its numbers. Two years ago there were less than 1,200 students in the Institute; to-day there are more than 1,400. In the present first-year class there are 439 students. The increase in numbers of the last two years would in itself constitute a good-sized technical school.

These students are drawn in large measure from those classes which are welcomed most gladly. A number are graduate students, a still larger proportion come from the West and South, while a considerable number come from abroad. Nevertheless, when one reflects that each regular student costs the Institute about $100 more than he pays, one realizes that this growth, gratifying as it is in one way, imposes upon us a constantly heavier burden, and demands constantly increasing resources. Should each former student return to the Institute the difference between his actual payment and the cost of his education, the sum would prove an ample endowment for the present.

Not only is it true that increasing numbers mean increasing cost, but we have already reached the limit of our buildings in matters of instruction. For instance, instruction in chemistry, physics, and in electrical engineering are given in the Walker Building, in addition to certain instruction in modern lauguages. At the present time there are being instructed in this building 684 men in chemistry, 848 men in physics, 89 men in electrical engineering, and a large number in modern languages. Even these numbers represent those left after a careful culling out of students who under ordinary conditions would be allowed to take these subjects and the cutting down of classes to the smallest possible numbers. In addition some relief has been afforded by the use of rooms, though ill-suited to the purpose, in an adjoining street; but at this moment every possible space is being utilized for every moment of the day.

For next year, when the present first-year class goes into the second year, and is followed by a similar class, I do not know how we shall be able to provide for them. The problem is one which is of so great importance that I cannot overstate its significance and the necessity of an immediate solution.

Foreseeing somewhat of this condition, the Executive Committee has recommended the erection on the Trinity Place ground of a building for electrical engineering, and

the equipment of that building with modern appliances for the teaching of that subject. But since the opening of the present term it is evident that even the removal of electrical engineering from the Walker Building would give scarcely momentary relief, and that, to deal with the problem effectively and to afford the provision for chemistry which is urgently demanded, it is necessary to move both physics and electrical engineering. Furthermore, additional investigation of the subject shows the great economy of keeping these departments in close contact.

To provide for the Department of Electrical Engineering alone would involve an expenditure for building and apparatus of about $275,000, while to erect a building capable of providing for both departments would cost about $350,000.

A most generous beginning has been made toward this new building by a subscription of $50,000 from the sons and daughters of our late colleague, Mr. Augustus Lowell, and an additional subscription of $10,000 from Mr. George A. Gardner, in all $60,000. I cannot but believe that, if the absolute need of the Institute were known, and if at the same time those who are interested in young men in America were aware of the opportunity afforded here for ministering to students from all parts of the United States, means would be provided without delay for meeting these immediate demands. The Institute of Technology has reason to be proud of what it has accomplished with modest financial resources. It would be an extraordinary condition of affairs if the response by the youth of the country to the instruction offered here should be so large that it should outstrip the facilities provided for that work.

Two courses seem open to us in meeting this problem. One is to cut down the number of students to the measure of our present working facilities by imposing such arbitrary conditions as may limit the number of those who can enter. The other way of meeting this problem is, while maintaining all proper standards of entrance requirements, and even

advancing these standards, to make the facilities for instruction so generous and so complete that the Institute of Technology may lead the world in the teaching of applied science, and that it may continue to draw to itself in yet larger numbers students from the whole country and the whole world.

I have found, now and again, some question as to the wisdom of opening without reserve our facilities to these students. Some ask, Why encourage students from Texas and from California, from England or from Australia, to come to the Institute of Technology? Why should Massachusetts supply the facilities for training those who may in the near future be using the skill thus gained in the service of her industrial rivals, domestic, or foreign?

Let me express the conviction that no institution of higher learning which undertakes to limit its ministry to its own section or to its own community is worthy of the highest devotion. And no man is worthy to direct such an institution who is willing to consider the problems of education from the sole standpoint of the upbuilding of the influence and power of the particular institution which he represents. College spirit and college devotion in the United States mean in too many instances devotion to the interests of a particular institution, and not devotion to the cause of education of the State, of the nation, and of the world. I believe profoundly that an institution which seeks to serve the purposes of the widest education and of the highest training best serves its own community when it serves best the citizens of the whole country and of the world. The attendance of students from abroad is the best barometer we have of our own alertness and our own fitness. And I am sure that, when the Institute of Technology ceases to serve as freely the student from abroad as the student from Massachusetts, when it ceases to attract to its lecture-rooms and to its laboratories the student from Texas and the Carolinas, from Washington and California, from England and Australia, from China and Japan, it will cease to serve efficiently the student from New England and the student from Massachusetts. After all, a

great institution of learning is like a great magnet. Its power grows in proportion as it attracts particles to it. Its power wanes when it ceases to carry its full load.

I earnestly commend to your attention the situation which I have just portrayed. I have endeavored to do my own duty in describing to you the situation as it exists; and I beg your assistance in bringing the facts which I have mentioned to the attention of those who have at heart the interests of Massachusetts, and of New England, and of the country.

The second enterprise already under way, to which I desire to call your attention, is the plan for the completion of what has been called the Walker Memorial Building. As you have already learned, $100,000 has been subscribed for this purpose by the past and present students of the Institute, of which $5,000 was the gift of the class of 1901 on its day of graduation. Never before, so far as I can ascertain, has a class of undergraduates given on their day of graduation, by united action of the entire class, $5,000 to their Alma Mater. When one considers that the alumni of the Institute are for the most part young men, their contribution of $100,000 is an unusual exhibition of loyalty. It is important, to my thinking, to meet this evidence of their devotion at least half-way, and to raise the remaining amount necessary to complete the building at the earliest possible moment.

The building as it is planned contemplates not simply a gymnasium, not simply a building for physical culture,— though it will serve both these purposes,— but it is to afford as well a place which shall be the social center of student life. No need is more urgently felt amongst the students of the Institute than that of closer contact with each other and with men from outside. The very fact that students do not live in dormitories, but in isolated houses, gives less opportunity to cultivate the social side. A graduate of the Institute is far more likely to fail by reason of lack of ability to deal with men than by lack of technical knowledge. He needs strengthening on the side of relationship

with other men rather than strengthening in a particular branch of a particular part of engineering.

Looked at from this standpoint, the Walker Memorial Building is to occupy to students a function no less important than that of any other means for instruction and training which the Institute supplies; and the need for the prompt and speedy completion of this building is felt no less keenly than that for increased facilities in technical instruction.

To make of this building one which shall accomplish the end in view, $100,000 is necessary in addition to that already subscribed by the past and present students. A member of our Corporation has made a generous start toward this by a subscription of $10,000, in addition to which other contributions have been received, bringing the total up to $25,000.

Should not every member of the Corporation take an active personal share in establishing a memorial to President Walker, who gave the best years of his life to the service of the Institute?

I beg to urge upon you, and through you upon those who are interested in young men and who believe that students are to be educated not only as engineers but as men, the need for a prompt completion of this subscription.

These two plans of the Institute, already begun, call for your careful, earnest, and, most of all, your immediate attention; and I commend them to you as enterprises which may well appeal to every citizen.

NEW MEMBERS OF THE CORPORATION.

Since my last report three members have been added to your body by the election of Mr. Elliot C. Lee, Mr. James P. Stearns, and Mr. Lucius Tuttle. They have been assigned to the following committees: Mr. Lee to the Visiting Committee on the Departments of Mechanical Engineering and Applied Mechanics and that of Chemical Engineering; Mr.

Stearns to the Visiting Committee on the Department of Civil Engineering and to the Committee on Finance; Mr. Tuttle to the Committee on the Department of Civil Engineering.

CHANGES OF FACULTY AND INSTRUCTING STAFF.

Professor Wells, who was granted leave of absence last year, has returned with improved health, and is taking his share of the work of the Department of Mathematics.

Professor Talbot has been appointed head of the Chemical Department. Professor Talbot graduated in the Department of Chemistry in 1885, and, except for two years of university study in Germany, has been continuously connected with the Institute, holding a full professorship since 1898. For a considerable period he has exercised an important share of the responsibilities of the head of a department; and the present action of the Executive Committee in giving him the formal appointment will, without involving any change of policy, conduce to more effective organization and conduct of the work of this important department and of our courses in Chemistry and Chemical Engineering.

Professor Homer, of the Department of Architecture, has accepted an appointment as Director of the Rhode Island School of Design at Providence, fortunately, however, continuing his lectures on the history of architecture to our students. Professor Homer graduated in the Department of Architecture in 1885, and has been connected with it in successive grades since 1887. In recent years he has also engaged in professional practice. Professor Homer carries with him to his new work the cordial esteem of his colleagues.

Professors Dippold, Currier, and Ripley have been advanced to professorships in their respective departments. Professor Dippold was appointed instructor in modern languages in 1886. He is a native of Frankfort on the Main, where he completed his course at the Gymnasium. After

attending lectures at Heidelberg, he came to America, and first occupied a position as tutor in German in Harvard University, 1870–73. After this he was instructor in French and Anglo-Saxon in Boston University, 1874–83, where he took the degree of Doctor of Philosophy. He was subsequently instructor in German in Wellesley College, and in 1883 at the Johns Hopkins University.

Professor Currier was appointed instructor in history in 1891. He graduated in 1887 from Harvard University, and in 1888 received the degree of Master of Arts from that institution. After further study at Harvard, chiefly in constitutional history, he spent a year at Berlin with Professors Gneist, Brummer, and others, and then a year at Paris in the École Libre des Sciences Politiques. In 1893 he assumed charge of the instruction in history, and has shown excellent capacity in the work.

Professor Ripley's appointment as associate professor was mentioned in my report of last year, with a brief statement of his previous record. I regret to have to add that Professor Ripley's connection with the Institute is to be terminated at the end of the present year by his resignation to accept a professorship in Harvard University, where he has been giving lectures during the present year. Professor Ripley's nine years of service at the Institute have been highly successful and productive. He enters a wider field of usefulness with our best wishes and high expectations.

Assistant Professors Puffer and Lawrence have been promoted to associate professorships in the Departments of Electrical Engineering and Architecture respectively. Professor Puffer graduated in Mining Engineering in 1884, and has been connected with the Departments of Physics and Electrical Engineering continuously since that time, becoming a member of the Faculty in 1893. He has had the main responsibility under Professor Cross for the conduct of the laboratory work in Electrical Engineering, and has this fall made an extended tour among European laboratories, with a view to securing the best attainable results in the

planning of the new building which has been authorized for that department.

Professor Lawrence has been successively instructor and assistant professor of architecture since his graduation in 1892. He has had the chief share in the development of our present engineering option in architecture,—a line of work of increasing interest and importance.

Among new Faculty appointments is that of Captain William Hovgaard, of the Royal Danish Navy, who becomes Professor of Naval Design, and will have charge of warship-design and of cognote courses of lectures. The work of the department has increased in scope and importance, particularly with the advent of the naval cadets this year. The special course planned for them has received the cordial approbation of the United States Department of the Navy.

The following instructors of last year were appointed assistant professors in the spring: Messrs. Derr, Wendell, and Norton, of the Department of Physics; Messrs. Whitney, Thorp, Fay, and Norris, in the Department of Chemistry; Messrs. Fuller, Johnston, and Park, in the Department of Mechanical Engineering. Of these, Messrs. Derr and Thorp graduated in 1889; Dr. Whitney, in 1890; Mr. Derr, Dr. Wendell, Mr. Fuller, Mr. Johnston, and Mr. Park, in 1892; Mr. Norton, in 1893. Messrs. Wendell, Whitney, and Thorp have during leave of absence taken the degree of Doctor of Philosophy in the University of Leipsic. Messrs. Fay and Norris have taken the same degree at Johns Hopkins University. All of these gentlemen have done important and responsible work as instructors, and their accession strengthens the Faculty. Messrs. Charles B. Breed, William S. Newell, Harrison W. Smith, Maurice de Kay Thompson, and Charles-Edward A. Winslow, assistants of last year, have been promoted to the rank of instructors.

Newly appointed instructors are: William J. Drisko, in the Department of Physics; Reginald R. Goodell, in the Department of Modern Languages; Charles E. Locke, in Mining Engineering and Metallurgy; and Henry L. Seaver, in English.

Mr. Drisko graduated from the Department of Physics in 1895, and was connected with the department, first as assistant, then as instructor, till 1899, when he resigned to become Professor of Physics in Colby College. Mr. Goodell graduated from Bowdoin College in 1893, and took the degree of Master of Arts in 1895. His time has since been given to teaching and to advanced study abroad and at Johns Hopkins University. Mr. Locke graduated in the Department of Mining Engineering in 1896, and has since that time been engaged in professional practice and in private work for Professor Richards. Mr. Seaver is a graduate of Harvard University, where he has also had successful experience in the teaching of English.

Instructors and assistants who have terminated their connection with the Institute are Messrs. W. L. Smith, N. E. Seavey, and C. H. Hapgood, of the Department of Physics and Electrical Engineering; C. H. L. N. Bernard, of the Department of Modern Languages; H. E. Andrews, in English; A. S. Merrill and F. R. Swift, in Mechanical Engineering; J. W. Brown and J. H. Walton, Jr., in Chemistry; H. C. Plummer and W. L. Stevens, in Mining Engineering; G. E. Russell and A. B. White, in Civil Engineering; and F. Cushman, Jr., in Mechanic Arts.

The following assistants have been appointed: John P. Sanborn, Jr., and Robert C. Valentine, in English; Edward P. Beckwith and Arthur C. Davis, in Chemistry; Frederick G. Clapp, in Geology; Francis B. Driscoll and Samuel L. Wonson, in Civil Engineering; Henry L. Kehl and Harry R. White, in Mechanical Engineering; John Boyle, Jr., William W. Garrett, and Frederic H. Sexton, in Mining Engineering; Warren I. Bickford, Francis E. Cady, Harry E. Dart, Clinton M. Dearden, Frederic W. Freeman, Herbert H. Kennedy, and George L. R. Mitchell, in Physics; James C. Woodsome, in Mechanical Drawing; and Charles E. Littlefield and Eugene S. Foljambe, in Mechanic Arts.

SCHOLARSHIPS.

The Executive Committee assigned for the present year $5,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 263, while 123 submitted applications for the 40 State scholarships. 62 of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 324. Of these, 28 have received scholarships to the amount of full tuition; 157 others have received smaller amounts, averaging somewhat more than $100 each. In accordance with the act of the Legislature authorizing division of State scholarships, 21 of the 40 were so divided, thus increasing the number of recipients to 61.

GRADUATE SCHOLARSHIPS.

The graduate scholars of the current year are Messrs. Arthur H. Birks, S.B., Robert R. Goodrich, S.B., Louis R. Henrich, S.B., William G. Holford, S.B., George T. Hyde, S B., Ellis F. Lawrence, S.B., Julius E. Ober, S.B., Langdon Pearse, S.B., Francis W. Puckey, S.B., and Bart E. Schlesinger, S.B., all of the class of 1901; Walter R. Kattelle, S.B., of the class of 1900, William C. Phalen, S.B., of the class of 1899, Henry A. Swanton, S.B., of the class of 1894, and John H. Morse, B.A., of the University of Nebraska. Of these students, five are working in the Department of Architecture, two in Chemistry, two in Civil Engineering, one in Electrical Engineering, one in Geology, and one in Naval Architecture, while one is taking special work in Drawing and Mechanic Arts.

FELLOWSHIPS.

The Savage Fellowship has been awarded to Mr. M. de K. Thompson of the class of 1898. Mr. Thompson, previously

an assistant in the Rogers Laboratory, has been appointed instructor in electro-chemistry, and is spending the winter in study at the Polytechnicum at Zürich.

The income from the Austin Fund has enabled us to continue the following appointments. Mr. Arthur A. Blanchard, of the class of 1898, and for two years assistant in theoretical chemistry; Mr. Louis P. Chapin, a graduate of the University of Minnesota and since 1897 assistant in general chemistry; and Mr. Miles S. Sherrill, of the class of 1899, assistant in analytical chemistry, are taking courses at the University of Leipsic. Mr. Joseph G. Coffin, of the class of 1898, for two years assistant in physics, is a graduate student at Clark University. In addition two new appointments have been made this year: that of Mr. John W. Brown, assistant last year in analytical chemistry; and that of Mr. James H. Walton, assistant in general chemistry, who are studying for the degree of Doctor of Philosophy at the University of Heidelberg.

STUDENT ADVISERS AND STUDENT LIFE.

During the past year, efforts have been made in one direction or another to assist students in their choice of studies and to give them such advice as should be helpful to them in their work and in their life. The members of the first-year class have been for several years assigned to members of the instructing staff for this purpose, and instructors so designated have been termed Advisers. This plan, while it has been productive of good, has not resulted in all that was expected. At the beginning of the present year the Advisers themselves were called together, and were invited to meet the students of the incoming class at the beginning of the term. This meeting resulted in the establishment of useful relations between students and Advisers; and, with some modification, it is hoped that the plan may have still further application next year.

One of the problems which confronts the young man

coming to the Institute, and which has not always been satisfactorily solved, has been that of securing comfortable quarters. A building is now being erected on Huntington Avenue which is to serve the purpose of a dormitory, or perhaps more nearly the purpose of the English University House. It will accommodate about one hundred and seventy-five men in a most comfortable fashion, and they will be provided with meals as well as rooms in the building. While not the property of the Institute, it will be conducted with the co-operation of its officers.

TECHNOLOGY FIELD DAY.

The action of the undergraduates of the Institute concerning athletics, taken during the past year, has been of a most satisfactory character. The members of the Corporation will recall the sad circumstances attending the celebration of what was known as the "Cane Rush" in November, 1900. Since that time, in a most frank and manly way, the undergraduates have taken up the question of changing this old-time celebration into some form of athletic contest which should be satisfactory and yet furnish a test of strength between the Sophomore and Freshman Classes. Incidentally, the entire question of athletics was discussed, and considerable thought was given to the forms of exercise consistent with the work of students of the Institute. As a result of the discussion, the student body voted to withdraw for the present from inter-college football, and to confine their participation in this game to the class contest. They voted, in addition, to substitute for the former "Cane Rush" a series of athletic contests, to be held on a day chosen for that purpose, and to be known as "Technology Field Day." These contests were successfully held, last November, in the presence of a large number of friends and graduates of the Institute; and the occasion proved not only a most interesting one from the standpoint of the events themselves, but also a most satisfactory one as marking a sensible solution of such a question by students.

ENTRANCE REQUIREMENTS AND EXAMINATIONS ABROAD.

The past year has seen a wide discussion among colleges in the matter of entrance requirements. The question is one which is of great importance to the Institute; and I have to report that the Faculty have adopted a resolution by which, after 1903, the definition of entrance requirements will be so changed as to require an applicant for admission to have done preliminary work in both German and French.

Examinations for admission have been held during the past year in a number of places, particularly in the South and West, where previously we have held none. The Faculty has accepted examinations for admission conducted by the College Examination Board of the Middle States and Maryland. Entrance examinations were held also in London in June last, for the first time, for the convenience of such English applicants as might wish to take advantage of engineering educational facilities in America. The results have been satisfactory; and, while the examinations have resulted in the attendance of only a small number of students from England, they have fulfilled their main object in stimulating the discussion of questions which concern engineering instruction both here and abroad.

CLASS OF NAVAL CADETS.

An interesting addition to our student body has been brought about in the presence of the Naval Cadets of the United States now here for instruction in naval architecture. The Navy Department appoints, each year, two or three men as Naval Cadets; and, beginning with the present term, these men are to be educated in the Department of Naval Architecture of the Institute of Technology. At present three cadets are pursuing work here, to be followed from year to year by a similar number. A special course in

naval architecture has been arranged to meet the needs of these students.

GIFTS FOR THE PAST YEAR.

The following gifts, in addition to the subscriptions for the Walker Memorial Building and the new building for Electrical Engineering, which have already been announced, have been available for the present year.

The General Court of Massachusetts has by its vote continued its annual appropriation of $25,000 for ten years.

The bequest made some years ago by Mr. Henry Saltonstall, a friend we love to remember, has become available during the present year.

I have also the pleasure to acknowledge the gift of a Westinghouse air brake by the Westinghouse Company, and of a milling machine which has proved a most valuable contribution to the physics laboratory, and which was provided by the thoughtfulness of Mr. Francis Blake. In addition to these I have to acknowledge the gift of a number of specimens of ores from the Colorado Fuel and Iron Company, and the gift of the painting, "The Discovery of Aniline," by the Fallon heirs.

I desire at this time to acknowledge the gift of a number of prizes, instituted by Mr. Samuel Cabot for individual physical improvement, which have proved to be a great stimulus toward physical excellence.

A free bed, provided by the Massachusetts General Hospital for the benefit of any student at the Institute in need of such facilities, has proved one of the most welcome gifts which could come to the student body. It has already been occupied by a number of students, and is gratefully accepted as a recognition on the part of the authorities of the Hospital of the work done by the Faculty of the Institute.

SOCIETIES AND PUBLICATIONS.

The various societies connected with the Institute are accomplishing in their separate fields work of an important sort. The alumni societies in other parts of the country have in the past year taken a new interest in the Institute and its work; and many evidences of this have come to the instructing staff, not only in the Walker Memorial subscription, but in suggestions and inquiries regarding the work of the Institute. This spirit is one which it is desirable to foster in every way, and one which I hope to see increase as time goes on.

One of the agencies which has contributed in large measure has been the Technology Club, which has, during the past summer, taken a new house on Newbury Street, and which is filling a constantly increasing place in ministering to the social life of the students and alumni.

The *Quarterly* and the *Review* have continued during the past year to serve their purpose admirably, and to contribute to a knowledge of the work of the Institute.

The Institute was represented at the Yale Bicentennial Celebration by a committee of the Faculty consisting of the President and Professors Sedgwick and Porter. It was also represented at the Pan American Exposition by an exhibit designed to show the nature of the work accomplished at the Institute. At the request of the authorities of the Charleston Exposition this exhibit has been removed to that exposition without cost to the Institute, and will remain there until the close of the exposition.

ECLIPSE EXPEDITION.

An expedition made up largely of members of the instructing staff of the Institute, under the leadership of Professor Burton, was sent last May to observe the total eclipse of the sun in Sumatra. The observations and photographs which they obtained, and which are now being discussed, promise results of interest and value.

REPORTS OF DEPARTMENTS AND STATISTICS.

There is given in the following pages a summary of the reports of the heads of the various departments, together with statistical information prepared in the office of the Secretary concerning attendance, choice of studies, and similar matters. The information contained in these reports and tables is of the highest value, and I commend it to your careful inspection.

HENRY SMITH PRITCHETT,
President.

BOSTON, Dec. 11, 1901.

REPORTS FROM THE DEPARTMENTS.

Civil and Sanitary Engineering.

No changes have been made in the course of study in Civil or Sanitary Engineering during the past year, and no important changes in the staff of instruction.

The number of students in this department is increasing; and the drawing-rooms are reaching the limit of their capacity, particularly that occupied by the second-year students. The Engineering Library also is growing very rapidly, and will within a short time be so crowded that some additional room will be required. This will render necessary further changes in the arrangement of the rooms of the department; and, in making plans for any new buildings, provision should therefore be made for additional space for this department, adjoining the quarters which it now occupies.

The demand for graduates in civil engineering has steadily increased. Since May there have been received applications for over one hundred and twenty young men to fill civil engineering positions; while the class which graduated last June, although the largest ever sent out, numbered but forty. Of these applications, thirty-five were for structural work, forty-one for railroad work, twelve for teaching, twelve for hydraulic work, and twenty-three for miscellaneous engineering work. In addition to these, during the spring of 1901, previous to May 1, there were some fifty other applications.

In December, 1900, the Base Line Apparatus, which has been in use in the Summer Schools of the Civil Engineering Department for the past five years, was tested by the officers of the United States Coast and Geodetic Survey, not only at Washington, D.C., but also under the conditions of actual

practice at the Alice Base Line in southern Texas. The test was favorable to the Institute apparatus; and a report by Assistant John F. Hayford, C.E., has been published in the June number of the *Technology Quarterly*.

The party sent to Sumatra to observe the total solar eclipse of May 18, 1901, consisted of Professor A. E. Burton and Mr. George L. Hosmer of the Civil Engineering Department; Mr. Harrison W. Smith, instructor in the Department of Physics; and Mr. Gerard H. Matthes, a graduate in civil engineering of the class of 1895, at present Assistant Hydrographer of the United States Geological Survey. An appropriation of $2,000 was made from the Austin Fund for this expedition, all expenses beyond this amount being met by private contributions. Through the courtesy of the Superintendent of the United States Coast and Geodetic Survey the party was furnished with the half-second pendulum apparatus, by which determinations were made of the force of gravity at several points near the earth's equator. Professor E. C. Pickering, of the Harvard College Observatory, kindly loaned the expedition two Clarke lenses, ground especially for eclipse photography. The outfit, in addition to the above, consisted of an astronomical transit with micrometer and latitude level, three chronometers and a chronograph, an equatorially mounted telescope with five-inch objective, a magnetometer, and a dip circle. The party left New York February 24, and arrived at Padang, on the west coast of Sumatra, April 6. The Dutch government gave generous assistance to the expedition, and an excellent location for the observing station was obtained at Sawah Loento in the interior of the island. Here three buildings were constructed to shelter the different pieces of apparatus, and masonry piers were erected for the three large cameras. The day of the eclipse was not perfectly clear, but at the time of totality the conditions were such as to enable Mr. Smith to secure several fine photographs of the corona. The shadow bands were seen distinctly both before and after totality, but the photographic records

of these bands are not entirely satisfactory. Magnetic observations showed slight disturbances of the magnetic needle. Pendulum observations were made at Sumatra, at Singapore, and afterwards at Washington, D.C. The party returned by the way of China, Japan, and the Sandwich Islands. A full report of the work of the expedition will soon be published in the *Technology Quarterly*.

It is interesting to note the extent to which instructors and assistants are engaging in professional work during the summer vacations. Such work is encouraged in order that the young men may come in touch with practical men and practical methods. During the past summer seven members of the department were engaged in bridge design and in surveying of various sorts.

The fourteenth session of the Summer School of Civil Engineering was held at Machias, Me., where the school was held in 1896 and 1897. Twelve students were in attendance. The work was in charge of Professor Robbins and Mr. Sweet, assisted by Messrs. Driscoll, Pearse, and Wonson of the class of 1901. The topographical work consisted of an extension of the plane-table sheets and triangulation of four years ago. The hydraulic work consisted of both tube and meter measurements of the flow of the Machias River and of a canal supplying one of the mills.

Soundings were made at Howard Bay, some eleven miles from Machias, where a tide-gauge was set up and continuous readings were taken to determine the mean sea-level. The location of the tide-gauge was the same as that occupied by the United States Coast and Geodetic Survey several years ago, and the elevation was referred to the bench mark of that survey on an adjoining ledge.

Mechanical Engineering.

The present school year 1901–1902 is the second of the option in heating and ventilation, the first of the new course in naval architecture given to the Naval Cadets, the first

in which an option in machine design is given to Course X., and the first in which the new engineering options in Courses V. and VIII., as well as the advanced course for graduates of Courses V. and VI., go into operation. All of these involve additional work on the part of the Mechanical Engineering Department.

If the laboratory is to continue to hold the position that it has held in the past, certain additional apparatus must be obtained, both in view of the increasing number of students to be provided for and also to enable us to make investigations along certain new lines which are of great importance from an engineering point of view.

Probably the two most complete investigations made in connection with thesis work during 1900–1901 relate, the first to the flow of air through orifices and the second to the explosion of gases. The formulæ for the flow of air used at the present time are based on the experiments of Fliegner. These experiments were made with orifices under 10.0 millimetres in diameter, and with pressures not greater than 80 lbs., and constantly decreasing. The apparatus at the Institute is arranged so that orifices up to two inches in diameter, or 51.3 millimetres, can be tested under constant pressures up to 350 lbs. During the past year orifices from three-sixteenths through five-eighths of an inch have been tested. Experiments have been conducted also to determine the explosive force of mixtures of gas and air under initial compression. Very little work has been done in this line outside of the tests made at the Institute. The work is especially valuable in connection with the study of gas-engines.

Through the kindness of the officials of the various railroads, opportunity has been furnished for some years to conduct road tests of locomotives in connection with the thesis work of the students. During the present school year the series of such tests is exceptionally complete.

Mining Engineering and Metallurgy.

The importance of metallography, the microscopical study of the structure of metals, is being more and more recognized. Even the iron foundries are now using this means for controlling the quality of their materials, in order to produce even and reliable results. The course in this subject has been transferred from the Chemical to the Metallurgical Department, where it naturally belongs. Lectures and laboratory work in this line have been added to the curriculum for all regular students in the Course in Mining Engineering and Metallurgy, and advanced work is provided also for those who elect this subject for a thesis or wish to work upon it with the view to obtaining an advanced degree. This work is under the charge of Professors Hofman and Fay.

The instructing force has been increased from three assistants, as it was last year, to four assistants and an instructor. A further increase may be needed next year,

The Summer School of Metallurgy was held in New York, New Jersey, Pennsylvania, and Maryland. The party had a fine opportunity to see the smelting of zinc for the formation of oxide as well as the production of spelter at the works of the New Jersey Zinc Company. The study of the metallurgy of copper was taken up at the works of the Nichols Chemical Company, the Baltimore Copper Company, and the Guggenheim Smelting Company. Iron blast furnaces and the Bessemer process were studied with the Maryland Steel Company and the Pennsylvania Steel Company; open hearth steel manufacture, with the Pennsylvania Steel Company, the Pencoyd Iron Company, and the Midvale Steel Company; the crucible steel process, at the works of the Atha Steel Company; and lead and silver smelting, with the Guggenheim Smelting Company.

A graduate course in mining and metallurgy has this year been added for students who can afford to give an additional year to professional study. It enables the student to take

additional mechanical and electrical studies, and then leaves him, by means of two options, the choice between mining and metallurgical work.

Architecture.

The steadily increasing number of our graduates returning to the Institute for a year's study is perhaps the most gratifying thing connected with the Department of Architecture. This year there are eleven Institute graduates and one from Columbia University pursuing advanced courses, and five of them are candidates for the degree of Master of Science. The year is not only a breathing-space in which to become better acquainted with the culture which our library gives, but it is the opportunity for a fuller application of practical problems and for continued study in professional work. It is the true means of fostering work of a high grade.

The option in architectural engineering has well met an important demand, and its high standard is fully acknowledged by the exceptionally good positions found for its graduates. It is already beginning to attract students from other universities; and we have at present one advanced student in the option, a candidate for the Master's Degree.

The option in landscape architecture will complete its first four years next June. These years have fully proved that we have made no mistake in adding this option to our course. The facilities offered by the Institute, and the unusual opportunities for outdoor study in close proximity, leave nothing to be desired. Notwithstanding the entire lack of precedent of a well-defined course of study for the landscape architect, the results of the year show need of only slight changes in that laid down. These will be carefully considered and attended to.

The prosperity of the country made itself so strongly felt last summer in the demands from architects for draughtsmen's services that our Summer School was given up. The demand came for every one we could send, experienced or

otherwise; and we could not advise against so good an opportunity of early acquaintance with the routine of an architect's office.

Chemistry and Chemical Engineering.

Reference was made in the President's Report of last year to the arrangement of five series of optional studies within the chemical course. These options were offered to students of the second year at the beginning of the school year 1900–1901; and at that time three students selected Option 1, thirteen students Option 2, and two students Option 5, while of the present second-year class six have selected Option 1, seven Option 2, one Option 3, three Option 4, and one is undecided as yet between Options 2, 3, and 4. On account of the necessary delay in bringing these options to the notice of the students of the first of these classes, it is probable that the selection made by the present second-year class is more nearly typical of what may be expected in the future; but the number of students entering Option 1 will probably increase as the advantages of this option for students intending to devote themselves to technical chemistry after graduation become better known.

The optional studies of the fourth year of the Course in Chemical Engineering have been increased by the introduction of a course in machine design and a course treating of the general principles of chemistry.

Minor changes in individual courses of instruction include an improved system of note-book correction in the laboratory of inorganic chemistry, by which the work of an increased number of students is more efficiently inspected than formerly and with less delay to the student; an increase in the number of excursions in connection with the course in industrial chemistry; a modification of the laboratory work in the examination of foods to meet the demand for a knowledge of food adulterants; and the introduction of a special course in the testing of air for students in the heating and ventilation option of the Mechanical Engineering Course.

The laboratories of industrial chemistry have been enriched by two gifts,—a set of the *Zeitschrift für angewandte Chemie*, given by Mr. Samuel Cabot of our Corporation, and a Gates rock-crusher, presented by the Allis-Chalmers Company of Chicago, through Mr. Cabot. The *Zeitschrift* is a valuable addition to the small supplementary library of technical works which is being brought together for the immediate use of students in industrial chemistry in the Pierce Building. The rock-crusher is an equally valuable addition to the laboratory equipment.

The large increase in the entering class of this year has already crowded the laboratory of inorganic chemistry; and the number of students who will be entitled to working places in analytical chemistry next autumn, in the second, third, and fourth years, exceeds by about thirty-five or forty the number of desks which can be provided, with the present laboratory space. All can be accommodated next year if an additional laboratory can be equipped on the second floor, but a still larger number must be provided for in 1903–1904; and, if the entering class increases in size, further provision for inorganic chemistry, both lecture-room and laboratory space, will then be unconditionally necessary. Besides the increase of space demanded for the two branches of the department just mentioned, other laboratories are in need of enlargement; and it is becoming more and more essential for the well-being of the Chemical Department that members of its instructing force should have both space and time at their disposal to be devoted to research work, and that such work should be a recognized part of their duties. Several of the private laboratories which it is now possible to provide are inadequate in size; and throughout the department small laboratories for special lines of work, such as are found in all the best foreign laboratories, and the newer American laboratories, are much desired. Not less important is the development of research laboratories for advanced students upon a more liberal scale than is now possible, and the need of a room to be used as a

chemical museum, referred to last year, is still felt. In view, then, of the necessity for the development of all branches of the Chemical Department, it is evident that the entire Walker Building is not too much to devote to chemical purposes, as soon as such a change is made possible by the increase in available buildings.

During the past summer Professor Talbot spent some time in the inspection of laboratories of technical chemistry in Germany and England, and in the examination of the general methods of teaching this subject employed in those countries. During a part of the year Professor Whitney has had a most successful connection with the laboratories of the General Electric Company at Schenectady, which has already resulted in the placing of several of our graduates in positions at that place. Mr. Rolfe has spent part of the year in Porto Rico, in connection with the sugar industries of the island.

Physics and Electrical Engineering.

Increase in the number of students and growth in the various courses of the department have been particularly marked the past year; and the beginning of the present term has found our lecture-rooms and laboratories more severely crowded than ever before,—a condition which, we trust, will be remedied on the erection of a new building in which a part, if not the whole, of our work may find suitable accommodation.

Much new apparatus and machinery has been added to the several laboratories. Especially should be mentioned the addition to our mechanician's shop of a Brown & Sharpe milling machine, the generous gift of Mr. Francis Blake, of the Corporation,—a machine which is of the utmost service in the large amount of construction which is carried on in the department.

In the matter of instruction much good is resulting from a system of conferences which has been introduced into a

portion of our laboratory exercises, especially in the Laboratory of Electrical Measurements. At intervals of a few days the student is subjected to an informal examination by the instructor, and in this way a close watch can be kept upon the work; while, on the other hand, an opportunity is given for valuable personal instruction. Such frequent conferences consume a great amount of time, but in no other way is it possible so to minimize the danger always present in the laboratory of the performance of the work by the student by rule of thumb. This system will be extended in other laboratories as far as the time of the instructors will allow.

The number of students in the Laboratory of Heat Measurements has been very greatly increased by the addition of the fourth-year students in Mechanical Engineering, so that the total number to be accommodated this term is one hundred and seventy-five. The engineering students now receiving instruction in the subject for the first time take up the testing of fuels and the measurement of high temperatures, including the temperature of furnaces. The instruction given to students of the courses in Chemical Engineering and Mining Engineering has been extended to cover the use of electric fusion processes for the preparation of carbides and other applications of the electric furnace.

Somewhat over a year since, as was fully explained in the last President's Report, a new option in electro-chemistry was established in Course VIII. The value of this course seems to have been appreciated by the public, since during the present term eleven students have entered it at the beginning of the second year, and two graduates from other colleges have come to us especially for this work, a number far in excess of the expectations of the department. The instruction of these students in technical electro-chemistry will next year necessitate a special laboratory with suitable equipment for such work, for which the graduate course in mining also calls.

Mr. M. de K. Thompson, for several years an assistant

in the Rogers Laboratory, has been appointed instructor in electro-chemistry, with leave of absence to study abroad. During the past summer Dr. Goodwin and Mr. Thompson have made an extended tour of inspection of the electro-chemical laboratories of the German and Swiss technical schools.

In connection with the erection of the proposed new laboratories of electrical engineering, Professor Puffer was granted a leave of absence for the first half of the present term, and has spent that time in a careful study of the principal foreign schools of electrical engineering, besides visiting many of the leading electrical plants and manufactories in England and on the Continent. He has returned with much valuable information.

An important advance has been made during the past year by the establishment of a graduate course in electrical engineering, open only to students who have completed our own or an equivalent undergraduate course, and leading to the degree of Master of Science. The studies included are almost entirely in advance of any now given in the Institute, and embrace a severe course of advanced study in theoretical and applied electricity, mathematics, and machine design.

Biology.

The appointment of an additional instructor in biology has made it possible to extend and materially improve the course in industrial microscopy which has long been a useful feature of the work of this department. Mr. Charles-E. A. Winslow, a graduate of the Institute in the class of 1898 and a Master of Science in 1899, after two years' service as assistant in biology, has been promoted to an instructorship, and given special charge of this subject.

Professor Sedgwick's work on the "Principles of Sanitary Science and the Public Health," which he has had in hand for three years past, is now in the press of the Macmillan Company. This volume will be of much service both in

our own work of instruction and to those of our graduates who are engaged or interested in civic and sanitary administration or engineering. It is the direct outgrowth of Professor Sedgwick's lectures on the subject.

Professor Hough has published in full in the American *Journal of Physiology* his paper, "Ergographic Studies in Neuro-muscular Fatigue," giving the results of investigation on the general physiology of fatigue, made in this laboratory during the past two years. Mr. Prescott, instructor in industrial biology, has nearly ready to issue from the press of Messrs. John Wiley & Sons, the translation of an important work by Professor Jean Effront of the Zymological Institute in Brussels, on the soluble ferments, or *Enzymes*, bodies of great scientific and practical importance to brewers, vinegar manufacturers, and others engaged or interested in fermentation industries. He is making an important series of studies on the fermentation of cane juice, and the lactic-acid bacteria.

In connection with the recent remarkable advances in our knowledge of the causation of malarial or swamp fever, and the connection of mosquitoes with malaria, mention should be made of valuable investigations by one of the lecturers in this department, Mr. William Lyman Underwood, whose work on the "Drainage, Reclamation, and Sanitary Improvement of Certain Marsh Lands in the Immediate Vicinity of Boston," prepared under the general supervision of Professor Sedgwick, and published in the *Technology Quarterly* last spring, is of more than local interest and importance. A practical extension of his work was a thesis by one of the graduating class in Sanitary Engineering, showing how the improved drainage already effected on the upper marshes might readily be extended by means of tide-gates to a much larger territory between Belmont and the Mystic River.

The greatest need of the Biological Department is still the opportunity for laboratory experiments upon water and sewage and their purification, and in industrial biology,

upon a larger scale than is now possible; and it is greatly to be hoped that means may soon be found to afford these opportunities to our students of biology, sanitary chemistry, and sanitary engineering. The scientific operation and management of the great municipal filtration establishments now being introduced into many of the cities of the United States and Canada require experience and knowledge such as can be derived with the best advantage only from such opportunities for experiment and practice.

General Studies.

Professor Ripley was granted leave of absence in January for the remainder of the academic year, in order to undertake an investigation of transportation for the United States Industrial Commission. A result of this work has been the accumulation of material illustrative of traffic and financial details of railroad administration. Several important gifts have been received, as, for example, that of a large map prepared by Mr. J. C. Stubbs, traffic manager of the Allied Harriman Railroads, showing competitive transcontinental routes in the United States. This map was prepared originally for the proceedings in arbitration relative to differentials upon the Canadian Pacific Railway. Mr. Samuel M. Felton, president of the Chicago and Alton Railroad, has also secured valuable official documents for the library, including reports of the Joint Rate Inspection Bureau at Chicago.

A graduation thesis, entitled "A Statistical Study of the Negroes of Cinclare Central Factory and Calumet Plantation, Louisiana," has been accepted for publication by the Bulletin of the United States Department of Labor, as one of a series dealing with the economic status of the negro in various sections of the South.

The English Department has, by the large increase of students in the first year, been forced to have more instructors. During the first term of the present year five men besides Professor Bates have been employed, one of them having

been called in for the term only. If the number of students is to be as great in the future, some provision will need to be made for increasing the working force of the department permanently.

In second-year English a new departure has been made in having the students write, instead of the essay formerly required, a summary of each lecture in note books which are subsequently corrected. The plan seems to be working well. This course brings out very strongly, however, the fact that a large majority of students need to be trained to read intelligently. Many of them are hardly able to take from the printed page much beyond the simplest facts; and, in general, their inability to get from literature any clear or forcible impression without the most careful help is striking and discouraging. If the present course in literature could be put into the third year and the time in the second year given to instruction in the line of clear-hea'ed reading, the result would be better, not only in the subject itself, but in the general development of intellectual perception and appreciation.

The number of students from outside courses taking as options Course IX. literature in one form or another is about the same as last year.

Geology.

A new mineralogical collection has been arranged by Dr. Warren, to be used particularly as a reference collection by the students in second-year mineralogy. He has also brought together a collection of crystals, and is mounting them upon small stands of wood for the purpose of teaching crystallography to a greater extent from the natural crystals. A new petrographical microscope of the most approved model has been purchased for the study of thin sections of rocks. About two hundred new sections have been made for the Institute during the past year, and are now ready for use.

The arrangement and the arduous work of labelling the specimens in the palæontological collection have been carried forward in a satisfactory manner. The collection has received numerous accessions as donations. The Institute is now well prepared for giving practical instruction in this branch of geological inquiry, and there is this year a larger class in palæontology than there has been before.

The collections of building stones and of minerals which were sent to the Paris Exposition have been returned in as good condition as could be reasonably expected. The Institute is now supplied with a collection in this line which is not surpassed in any collegiate institution in this country. The Institute has also received a large and valuable collection of coals of different kinds from Colorado.

Professor Crosby spent over three months of the past summer in the West, chiefly in Colorado, Utah, Arizona, and the Yellowstone National Park. His time was mainly divided between original geological investigations and professional work in connection with mines, the latter affording excellent opportunities for the study of ore-deposits and the collection of instructive series of specimens for the Institute collection in economic geology.

The total membership of the classes taught in the department during the year is five hundred and one.

Naval Architecture.

The most notable event of the year is the decision of the Navy Department to send cadets to the Institute to receive special instruction in naval construction. A three years' course for these cadets has been adopted by the Faculty, and has received the approval of the Chief Constructor, covering the work of the third and fourth years of the regular Course in Naval Architecture, and providing for a year of graduate work. This course leads to the degree of Master of Science. At present there are three cadets at the Institute beginning this course. The course includes advanced

work in naval architecture and in warship-design and also advanced mathematics, electrical engineering, steam engineering, and marine engineering. It has a number of special courses, such as sanitation of warships, heating and ventilation of ships, and chemistry of organic materials used in ship-building.

The steady work of the department in securing drawings of ships and their engines, and other data required in ship-design, and the experience of the department in the adaptation of this material to the purposes of instruction, has made it possible to make material improvements in the teaching of ship-design without increasing the allotted time. The design of a ship is given to each student, who develops it alone, and uses it as the basis for computations of stability, strength, and other properties, as well as for instruction in construction and arrangement. Much credit for the recent development in this line is due to Mr. Leland.

The department has been fortunate in making large additions to its collection of drawings of merchant-ships and warships within the last year, and now has a systematized and catalogued file of drawings of ships of various types, arranged so that they may be used, as are such collections in the drawing offices of ship-yards, as a basis for ship-design. Through the liberality of the Navy Department the file of warship drawings is sufficiently complete for purposes of instruction; and this file will doubtless be kept up to date as new work for the Navy is completed. The aid of friends of the Institute is desired to increase the file of merchant-ship drawings, especially of recent ships.

Several models of ships have been added to our collection, notably of several sailing-ships and steamships of recent design presented by Dr. C. G. Weld, and of several wooden ships of about 1840 presented by Mr. C. B. Appleton. The department has added to its collection of instruments a pelorus by Ritchie, an integraph by Coradi, and some integrators by Amsler.

A large number of tests on steamers have been made by

students as the basis of theses. In the preparation of such work, tests were made by students of the class of 1901; and there are now five tests made or arranged for the present fourth-year class.

The work of the department is seriously hampered by the lack of room. To meet the immediate needs of the department, all the allotted space has been thrown into one drawing-room, the model and instrument room, which was also used for storing and caring for drawings and notes, being thereby sacrificed. Even if there were room (as there is not) for drawing-cases in the open drawing-room, our drawings could not be placed in such cases, as all the important drawings were given as confidential information; and the drawings of warships are furnished with that explicit statement. The addition of another professor to the staff of the department calls for a proper private office; and, as the work of the cadets proceeds, it will be desirable, if not imperative, that those in the higher classes be given special facilities and opportunity for uninterrupted work.

It is a matter of congratulation that our graduates have so generally found desirable employment in their profession in private ship-yards or in connection with other shipping interests, and in the bureaus of construction and steam engineering of the Navy Department. Already some of the older men are taking positions of responsibility.

The facilities which have been given for mold-loft work at the Navy Yard have gradually been restricted by the increased activity accompanying the growth of the Navy, until the Institute must look to some way of providing for this important work within its own walls. Methods consonant with the latest practice in some of our best ship-yards may be provided without demanding space beyond the possibilities of the Institute, and steps in that direction should be taken soon if this work is to proceed.

Modern Languages.

The increasing size of the sections and the addition of new courses in Spanish, to meet a growing demand, have greatly increased the work of the department. In view of the fact that instruction in a living language depends less on home work and written examinations than on the direct influence of the individual teacher, the sections in modern languages, to attain the best results, ought not to exceed twenty pupils.

It is gratifying to note the extent to which members of the department are engaging in literary or philological work, in addition to their teaching. The second edition of Professor Rambeau's "Chrestomathie Française," with an introduction upon French pronunciation and the phonetic method, appeared last June; and Professor Rambeau has brought home from France additional material for his history of the French drama. Besides the publications of other members of the department noted elsewhere, the following works are in preparation: a German grammar, by Professor Dippold; Storm's "Geschichten aus der Tonne," edited by Professor Vogel; "Una en Otra," by Fernán Caballero, edited with an introduction, notes, and vocabulary by Mr. Erhardt; and Pierre Loti's "Pêcheur d'Islande," edited by Mr. Goodell.

Mechanic Arts.

The total number of students taking instruction in mechanic arts is two hundred and ninety-four. Many of these take work in more than one subject.

The total numbers of students since 1897–98 are as follows: —

1897–98	210
1898–99	231
1899–00	238
1900–01	272
1901–02	294

The number of students attending the various classes in mechanic arts in the Summer School was twenty-nine.

The machine shop accommodates twenty-three students, and is now filled by the class in machine-tool work, having two sections of twenty-three students each. As was the case last year, several students desiring to take the work had to be excluded on account of lack of lathe equipment. Should the present rate of increase in numbers continue, another section in this subject, necessitating some rearrangement of other courses, will be needed, or some additional lathes will need to be provided

Instruction rooms similar to that of the machine shop are very much needed and should be provided for the woodworking and forging departments.

The old Brainard milling machine has been exchanged for a modern machine of the same make. A new arbor press and a straightening press have been added to the equipment of the machine shop.

PUBLICATIONS OF MEMBERS OF THE INSTRUCTING STAFF.

Civil and Sanitary Engineering.

G. F. SWAIN.—Reports on Steam and Street Railway Bridges. *Report of the Massachusetts Railway Commission*, pp. 39–44, 80–82. January, 1901.

C. F. ALLEN.—To what Extent and in what Direction is it Desirable for a Professor of Engineering to accept Engineering Employment? *Proceedings of the Society for the Promotion of Engineering Education*, Vol. IX. p. 227.

A. E. BURTON with J. F. HAYFORD, C.E., of the U. S. Coast and Geodetic Survey. Test of the Massachusetts Institute of Technology Tape Apparatus. *Technology Quarterly*, Vol. XIV. pp. 82–88.

F. P. MCKIBBEN.—Fire and Loading Test on a Columbian Fire-proof Floor. *Engineering News*, November 23, 1901.

Mechanical Engineering.

G. LANZA.—Notes on Friction. Revised edition.

G. LANZA.—Laboratoires de l'Institute of Technology à Boston. An abstract is published in the *Proceedings of the Congrès International de Mécanique appliquée*, Paris, 1900.

E. F. MILLER (Editor).—Results of Tests made in the Engineering Laboratories, Number XIII. *Technology Quarterly*, September, 1901.

J. C. RILEY.—The Pulsometer Steam Pump. *Technology Quarterly*, Vol. XIV., No. 3.

Mining Engineering and Metallurgy.

R. H. RICHARDS.—Progress of Gold Milling during 1900. *The Mineral Industry*, Vol. IX. p. 353.

R. H. RICHARDS.— Review of the Literature of Ore-dressing in 1900. *The Mineral Industry*, Vol. IX. p. 731.

H. O. HOFMAN.— Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. IX. p. 439.

Architecture.

H. W. GARDNER.— Notes on Shades and Shadows. 1901.

Chemistry.

A. A. NOYES and A. G. WOODMAN (Editors).— Review of American Chemical Research for 1901. Reviewers, W. O. Crosby, Henry Fay, A. H. Gill, H. M. Goodwin, H. O. Hofman, F. J. Moore, J. F. Norris, A. A. Noyes, E. H. Richards, G. W. Rolfe, H. P. Talbot, F. H. Thorp, C. H. Warren, A. G. Woodman.

W. R. WHITNEY and J. E. OBER.— The Precipitation of Colloids by Electrolytes. *Journal of the American Chemical Society*, Vol. XXII. p. 842.

HENRY FAY and EDWARD NORTH, 2d.— On the Nature of Lead Amalgams. *American Chemical Journal*, Vol. XXV. p. 216.

HENRY FAY and C. B. GILLSON.— The Alloys of Lead and Tellurium. *Transactions of the American Institute of Mining Engineers*, 1901.

HENRY FAY and H. E. ASHLEY.— The Alloys of Antimony and Tellurium. *Transactions of the American Institute of Mining Engineers*, 1901.

HENRY FAY.— Segregations of Phosphorus in a Piece of Cold Rolled Shafting. *The Metallographist*, April, 1901.

J. F. NORRIS.— Report on the Chemistry of the Purine Group. *American Chemical Journal*, Vol. XXVI. p. 463.

J. F. NORRIS.— On the Non-existence of Trivalent Carbon. *American Chemical Journal*, Vol. XXV. p. 117.

J. F. NORRIS and W. W. SANDERS.— On Triphenylchlormethane. *American Chemical Journal*, Vol. XXV. p. 54.

J. F. Norris and W. A. Kingman.— On the Isomerism of Selenates and Tellurates. *American Chemical Journal*, Vol. XXVI. p. 318.

J. F. Norris and Erik H. Green.— Some New Derivatives of Secondary Butyl Alcohol. *American Chemical Journal*, Vol. XXVI. p. 293.

J. F. Norris and Erik H. Green.— The Condensation of Carbon Tetrachloride with Halogen Derivates of Benzene by Means of the Friedel and Crafts Reaction. *American Chemical Journal*, December, 1901.

J. F. Norris and Grace MacLeod.— On the Preparation of Triphenylmethane. *American Chemical Journal*, December, 1901.

Ellen H. Richards.— The Cost of Food. John Wiley & Sons, New York, 1901.

Ellen H. Richards and Isabel F. Hyams.— Notes on *Oscillatoria Prolifica* (Greville). *Technology Quarterly*, December, 1901.

A. G. Woodman and L. L. Cayvan.— The Determination of Phosphates in Potable Waters. *Journal of the American Chemical Society*, Vol. XXIII. p. 96.

A. G. Woodman and Ellen H. Richards.— Air Testing for Engineers. *Technology Quarterly*, June, 1901.

A. G. Woodman.— A Portable Outfit for Water Analysis. *Technology Quarterly*, December, 1901.

Physics and Electrical Engineering.

C. R. Cross.— Silas Whitcomb Holman (biographical notice). *Proceedings of the American Academy of Arts and Sciences*, Vol. XXXVI. p. 553. *Science*, Vol. XIII. p. 857, May 31, 1901.

H. E. Clifford.— Notes on Heat. Third revised edition with additions. Printed for use of students in the Institute.

F. A. Laws.— Physical Laboratory Notes by Silas W. Holman, Part II. Electrical Measurements, Ninth Edition, revised with additions by F. A. Laws. Printed by the Institute.

H. M. GOODWIN.— Notes on Physical Laboratory Experiments in Heat, November, 1901. Printed by the Institute.

L. DERR.— The Precision of the Slide Rule. *Technology Quarterly*, March, 1901. *Railroad Gazette*, August, 1901.

C. L. NORTON.— Some Electrical Furnaces for Laboratory Use. *Electrical World and Engineer*, Vol. XXXVI. p. 957, December, 1900.

C. L. NORTON.— Fire and Load Test on a Concrete Floor. *Insurance Engineering*, Vol. I. p. 481, December, 1900.

Biology.

W. T. SEDGWICK.— On the Origin and Scope of Bacteriology. President's Address, Society of American Bacteriologists. *Science*, January, 1901.

W. T. SEDGWICK.— On the Rise and Progress of Water Supply Sanitation in the Nineteenth Century. *Journal New England Water Works Association*, March, 1901.

T. HOUGH.— Ergographic Studies in Neuro-muscular Fatigue. *American Journal of Physiology*, Vol. V., May, 1901.

R. P. BIGELOW.— The Stomatopoda of Porto Rico. *United States Fish Commission Bulletin*, Vol. II. pp. 149–160. 1901.

R. P. BIGELOW.— Chromosomes and Differentiation. *Reference Hand-book of the Medical Sciences*, Revised Edition, Vol. III. pp. 72–75, 467–469. 1901.

R. P. BIGELOW and H. S. CONANT.— Notes on Variation in the Shells of Purpura-lapillus. *Biological Bulletin*, Vol. II. No. 6, p. 361. 1901.

S. C. PRESCOTT.— On the Applications of Bacteriology to Certain Arts and Industries. *Technology Quarterly*, Vol. XIV. p. 2, June, 1901.

S. C. PRESCOTT and W. L. UNDERWOOD.— On the Cause and Prevention of Sour Peas. *The Canner and Dried Fruit Packer*, February, 1901.

W. L. UNDERWOOD.— On the Drainage, Reclamation, and Sanitary Improvement of Certain Marsh Lands in the Immediate Vicinity of Boston. *Technology Quarterly*, Vol. XIV. No. 1, March, 1901.

C.-E. A. WINSLOW.— On Typhoid Fever at Newport, R.I., in 1900, and its Relation to Defective Sanitation. *Technology Quarterly*, Vol. XIV. No. 2, June, 1901.

C.-E. A. WINSLOW.— Notes and Reviews of Vital Statistics, Statistics of Institutions, etc. *Quarterly Publications of the American Statistical Association*, September, 1900. December, 1900. June, 1901.

General Studies.

D. R. DEWEY.— Education for Commerce. *Technology Review*, April, 1901.

D. R. DEWEY.— Review of Knox's History of Banking in the United States. *American Historical Review*, January, 1901.

D. R. DEWEY.— Review of Bullock's Essays on the Monetary History of the United States. *American Historical Review*, April, 1901.

ARLO BATES.— The Neglected Side of Athletics. *The Forum*, April, 1901.

ARLO BATES.— Life and Letters of To-day. Ten papers. Chicago *Record-Herald*, June, July, and August, 1901.

ARLO BATES.— Talks on Writing English. Second Series. September, 1901.

Geology.

W. O. CROSBY.— Geological History of the Hematite Iron Ores of the Antwerp and Fowler Belt in New York. *Technology Quarterly*, September, 1901.

W. O. CROSBY.— Tripolite Deposits of Fitzgerald Lake, near St. John, New Brunswick. *Technology Quarterly*, June, 1901.

W. O. Crosby. — Reviews published in the *Technology Quarterly* and in the *American Geologist*.

G. H. Barton. — Outline of Dynamical and Structural Geology.

G. H. Barton. — Questions on Dynamical and Structural Geology.

C. H. Warren. — Mineralogical Notes. *American Journal of Science*, May, 1901.

C. H. Warren. — Reviews published in the *Technology Quarterly* and in the *American Geologist*.

F. G. Clapp. — Geological History of the Charles River. *Technology Quarterly*, September and December, Vol. XIV., 1901.

Modern Languages.

A. Rambeau. — Chrestomathie Française. Second Edition.

A. Rambeau. — Castilian Pronunciation. *Maître Phonétique*, October and November, 1901.

F. Vogel. — "Lichtenstein" von Wilhelm Hauff. Edited with introduction and notes.

F. H. Dike. — "Monsieur Bergeret." Extracts from the series "L'Histoire contemporaine," by Anatole France. Edited with introduction and notes.

R. R. Goodell. — "L'Enfant Espion," and other stories.

THE LIBRARIES.

The total number of additions to the libraries during the year 1900–01 was 4,567, of which 1,376 were by purchase, 920 from the bindery, and 2,271 were gifts. After deducting books counted twice, etc., the total net increase in the size of the library amounts to 3,567 volumes, 803 pamphlets, and 105 maps. The distribution and cost of these is shown in the following table.

TABLE OF THE NET ACCESSIONS FOR THE YEAR 1900–01, WITH THE COST OF THE SAME, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1901.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library. General	361	208	1	$117.22	4,935	3,913
General Library. English	111	2	—	203.48	2,782	40
General Library. Modern Languages	98	—	1	284.67	932	24
General Library. Military Science	170	—	—	15.50	320	7
Totals	740	210	2	$620.87	8,969	4,004
Architecture	174	3	—	578.98	2,813	213
Biology	164	33	—	258.43	2,535	466
Chemistry	424	41	—	741.38	8,368	1,638
Engineering	589	204	7	894.63	10,081	3,994
Geology	114	53	94	110.89	2,188	974
History and Economics	651	110	1	479.09	10,808	3,336
Mathematics	83	15	—	251.11	1,118	191
Mining	350	64	1	415.48	2,939	494
Physics	277	70	—	501.38	6,982	820
Margaret Cheney Room	1	—	—	—	617	13
Totals	3,567	803	105	$4,852.24	57,418	16,143

The number of serial publications received regularly by the Institute during the year 1900–01 was 798, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1900–01.

Libraries.	Number Received.						Estimated Cost.		
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Departmental Accounts.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General		13	14*	40	68	$61.12	$31.20	$126.06	$214.18
Architecture	7	10	2	34	53	57.73	4.80	173.49	235.22
Biology	5	7	17*	37	66	24.32	33.60	226.66	278.98
Geology	7	2	3	9	21	13.20	7.20	39.96	59.16
Chemistry	16	27	17	31	91	87.75	40.80	166.18	287.93
Engineering	19	38	66*	55	178	101.64	156.00	230.93	462.58
History and Economics	40	62	4	54	160	115.76	9.60	203.94	327.70
Mathematics	1	—	—	17	18	—	—	63.33	63.33
Mining	11	3	22	23	59	6.83	52.80	88.69	139.52
Physics	15	15	27*	24	81	55.13	60.40	117.45	224.58
Mass. School of Design	—	—	—	3	3	—	—	10.00	10.00
Totals	122	177	172	327	798	$523.49	$398.40	$1,845.09	$2,368.58

The expenditures for the libraries, exclusive of salaries, were as follows: —

Books and binding	$4,852.24
Periodicals	1,923.00
Supplies	141.46
	$6,916.70
Less receipts from the sale of duplicates	130.00
Total	$6,786.70

The General Catalogue contained on September 30 the very considerable number of 53,110 cards, of which 3,316

* More than one publication received in exchange for a single copy of the *Quarterly*.

had been added during the year. There were issued during the year 1,121 orders for new books and 1,135 for binding. In three of the libraries the number of books borrowed during the year was as follows: —

General Library	1,165
Engineering "	1,046
Chemical "	1,894

Among the most noteworthy gifts of the year may be mentioned three handsome volumes on the Eiffel Tower from M. G. Eiffel; from Edward Whymper, Esq., a set of his works; and from Mrs. F. A. Walker, 197 volumes from General Walker's library. We have also received from Mr. John J. May 24 volumes on chemistry, geology, and surveying from the library of the late William C. May of the class of 1873; and Mrs. Dwight N. Marble has presented to the Institute 19 volumes, and a number of pamphlets formerly belonging to her husband, who was of the class of 1895.

STATISTICS.

The Corps of Instructors.

The catalogue of this year shows the number of instructors of all grades to be 149, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 189. This year's catalogue will show a decrease of two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and five-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1900–01.	1901–02.
Professors	25	29
Associate Professors	11	9
Assistant Professors	27	25
Instructors	44	50
Assistants	32	36
Lecturers	42	40
Total	181	189

Students and Graduates.

The registration of this year, as shown by the catalogue, amounts to 1,415. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1869–70	206
1866–67	137	1870–71	224
1867–68	167	1871–72	261
1868–69	172	1872–73	348

Year.	No. of Students.	Year.	No. of Students.
1873–74	276	1888–89	827
1874–75	248	1889–90	909
1875–76	255	1890–91	937
1876–77	215	1891–92	1,011
1877–78	194	1892–93	1,060
1878–79	188	1893–94	1,157
1879–80	203	1894–95	1,183
1880–81	253	1895–96	1,187
1881–82	302	1896–97	1,198
1882–83	368	1897–98	1,198
1883–84	443	1898–99	1,171
1884–85	579	1899–1900	1,178
1885–86	609	1900–1901	1,277
1886–87	637	1901–1902	1,415
1887–88	720		

Students by Classes.

The aggregate number of students for 1901–02 is divided among the several classes, as follows: —

Fellows	7
Graduate students, candidates for advanced degrees	9
Regular student, Fourth Year	175
" " Third "	179
" " Second "	236
" " First "	396
Special students	413
Total	1,415

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	16	—	16
Fourth Year	175	93	268
Third Year	179	142	321
Second Year	236	134	370
First Year	396	44	440
Total	1,002	413	1,415

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class .	24	41	14	16	13	31	5	1	3	10	7	—	10	175
3d " "	31	34	35	10	9	26	1	1	1	9	5	1	16	179
2d " "	47	54	27	14	13	39	—	11	5	11	2	—	13	236
Total	102	129	76	40	35	96	6	13	9	30	14	1	39	590

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1891	81	104	17	33	23	108	11	5	19	28	9	3	—	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	—	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	—	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582*
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years: —

* Deducting those counted twice.

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st	2	–	–	–	–	–	–	–		–	–	–	–	–
2d	4	1	2	–	–	–	1	–	–	–	–	–	–	–
3d	4	–	–	2	–	–	1	–	–	–	–	–	–	1
4th	17	4	2	3	–	–	3	–	–	–	3	–	–	2
5th	8	1	4	–	–	–	3	–	–	–	–	–	–	–
	35	6	8	5	–	–	8	–	–	–	3	–	–	3

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study: —

Applied Mechanics	115	History	100
Architecture	44	Language	192
Biology	26	Mathematics	180
Chemistry	153	Mechanic Arts	93
Civil Engineering	103	Mechanical Engineering	120
Drawing	155	Mining Engineering	39
Electrical Engineering	33	Naval Architecture	11
English	139	Physics	255
Geology	57	Political Science	97

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years: —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	433	316	133	4	886
Chemistry	447	54	108	75	684
English	391	318	23	5	737
French	203	127	58	—	388
Physics	—	345	317	166	828
German	124	247	171	1	543
Mechanic Arts	6	146	55	56	283

Summer Courses.

The attendance at summer courses this year was as follows: —

Mechanical Drawing and Descriptive Geometry (Professor Faunce)	53
Mathematics: Analytic Geometry (Mr. Passano)	17
Architecture:	
(*a*) Shades and Shadows (Mr. Gardner)	5
(*b*) Elementary Design (Mr. Gardner)	6
Chemistry:	
(*a*) General Chemistry (Mr. Phelan)	23
(*b*) Analytical Chemistry (Mr. Hall)	12
(*c*) Organic Analysis (Dr. Mulliken)	7
(*d*) Organic Chemistry (Dr. Mulliken)	3
Physics:	
(*a*) Mechanics, Light, and Electricity (Dr. Wendell)	37
(*b*) Heat (Professor Clifford)	19
(*c*) Physical Laboratory (Dr. Goodwin)	6
Modern Languages:	
(*a*) French (Mr. Blachstein)	3
(*b*) German (Professor Vogel)	12
Mechanism (Professor Park)	23
Mechanical Engineering Drawing (Professor Park)	19
Mechanic Arts:	
(*a*) Woodwork (Mr. Merrick)	5
(*b*) Forging (Mr. Lambirth)	3
(*c*) Chipping and Filing (Mr. Smith)	2
(*d*) Machine-tool Work (Mr. Smith)	15
(*e*) Metal Turning (Mr. Smith)	3
English Composition (Mr. Robinson)	1

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	–	–	–	1	1	2
Arkansas	–	–	–	1	–	1	–	1
California	–	–	1	2	2	5	4	9
Colorado	–	1	1	–	–	2	4	6
Connecticut	1	6	4	7	11	29	13	42
Delaware	–	–	1	–	1	2	1	3
Dist. of Columbia,	–	2	2	5	2	11	3	14
Florida	–	–	–	1	–	1	–	1
Georgia	–	–	1	–	2	3	1	4
Hawaiian Islands,	–	–	–	–	–	–	–	–
Idaho	–	–	–	1	–	1	–	1
Illinois	–	7	9	7	7	30	14	44
Indiana	–	–	5	2	2	9	2	11
Iowa	–	–	1	2	2	5	3	8
Kansas	–	–	–	–	1	1	–	1
Kentucky	–	–	–	–	5	5	4	9
Louisiana	–	–	–	–	–	–	1	1
Maine	–	2	5	6	9	22	8	30
Maryland	–	1	2	4	3	10	6	16
Massachusetts	13	114	99	145	254	625	212	837
Michigan	–	2	2	1	2	7	5	12
Minnesota	–	2	2	–	2	6	4	10
Missouri	–	1	1	1	8	11	8	19
Montana	–	–	1	1	–	2	2	4
Nebraska	–	1	–	1	–	2	1	3
Nevada	–	–	–	–	–	–	–	–
New Hampshire	–	2	5	5	8	20	11	31
New Jersey	–	3	–	1	1	5	1	6
New York	1	6	8	17	22	54	25	79
North Carolina	–	–	1	1	1	3	3	6
Ohio	–	1	4	4	8	17	10	27
Oregon	–	–	–	–	1	1	1	2
Pennsylvania	–	5	8	5	6	24	12	36
Porto Rico	–	–	–	–	–	–	1	1
Rhode Island	–	3	6	5	9	23	15	38
South Carolina	–	–	–	1	–	1	2	–	2
South Dakota	–	–	–	1	–	1	2	–	2
Tennessee	–	–	–	1	–	1	–	1	1
Texas	–	–	1	–	–	1	3	4	4
Utah	–	–	2	1	2	1	6	1	7
Vermont	–	–	5	–	4	8	11	4	15
Virginia	–	–	1	1	1	3	2	5
Washington	–	–	–	2	2	1	4	–	4
West Virginia	–	–	–	–	1	1	–	1
Wisconsin	–	3	–	–	5	8	3	11
Foreign Countries.								
Austria	–	–	–	–	1	1	–	1
Bermuda	–	–	–	–	1	1	1	2
Brazil	–	1	1	–	2	4	–	4
Chili	–	–	–	–	1	1	1	1
China	–	–	–	–	1	1	–	1
Cuba	–	–	–	–	1	1	–	1
Denmark	–	–	1	–	–	1	–	1
England	–	–	–	–	1	1	2	3
France	–	–	1	–	–	1	–	1
Germany	–	1	–	1	–	2	1	3
Jamaica	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	2	2
Mexico	–	–	–	–	4	4	3	7
New Brunswick,	–	–	–	–	1	1	1	2
Nova Scotia	–	–	2	1	1	4	2	6
Ontario	–	–	–	–	1	1	2	3
Quebec	1	–	–	–	–	1	1	2
Russia	–	–	–	–	–	–	1	1
Turkey	–	1	–	–	–	1	–	1
Total	16	175	179	236	396	1,002	413	1,415

Forty-two States of the Union, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,415, 837 are from Massachusetts, or 59.2 per cent. of the whole; 156 are from other New England States; 422 are from outside New England. Of these, 43 are from foreign countries.

A table showing the number of students in each year, from 1895, coming from each State or Territory, and from each foreign country, may be not without interest and instruction: —

States.	1895	1896	1897	1898	1899	1900	1901
Alabama	–	1	1	1	–	1	2
Arkansas	–	1	1	–	–	1	1
California	8	9	9	11	9	10	9
Colorado	7	7	8	8	7	8	6
Connecticut	27	24	30	26	29	35	42
Delaware	5	5	6	3	4	4	3
Dist. of Columbia	16	17	13	8	7	13	14
Florida	1	–	1	–	1	1	1
Georgia	2	3	4	4	3	3	4
Hawaiian Islands		–	–	1	–	1	–
Idaho	1	1	1	–	–	–	1
Illinois	42	45	40	51	36	39	44
Indiana	2	3	7	3	5	7	11
Iowa	12	14	12	7	6	10	8
Kansas	4	3	3	–	–	–	1
Kentucky	11	12	10	10	4	5	9
Louisiana	2	–	1	1	1	2	1
Maine	38	27	24	19	25	22	30
Maryland	9	9	8	8	8	13	16
Massachusetts	721	730	730	710	731	770	837
Michigan	7	6	5	9	10	8	12
Minnesota	5	7	8	11	10	7	10
Missouri	9	11	6	10	11	13	10
Montana	1	3	5	2	3	5	4
Nebraska	2	2	2	1	3	4	3
Nevada	–	–	–	–	1	1	–
New Hampshire	10	26	25	25	29	26	31
New Jersey	5	13	15	13	12	8	6
New Mexico	1	–	–	–	–	–	–
New York	64	69	62	68	61	68	79
North Carolina	–	1	1	2	2	2	6
Ohio	37	28	30	23	27	27	27
Oregon	1	4	3	3	2	1	2
Pennsylvania	36	42	41	34	33	37	36
Rhode Island	21	20	19	23	32	35	38
South Carolina	5	6	4	1	1	1	2
South Dakota	–	–	–	–	1	1	2
Tennessee	1	1	3	3	4	6	4
Texas	3	2	2	1	2	4	7
Utah	5	2	3	5	6	7	7
Vermont	5	7	11	12	12	15	15
Virginia	5	3	4	3	2	3	5
Washington	1	5	4	7	4	2	4
West Virginia	3	2	1	–	1	1	1
Wisconsin	7	6	6	8	7	8	11
Wyoming	–	1	–	–	–	–	–
Foreign Countries.							
Austria	–	–	–	–	–	–	1
Belgium	–	–	–	–	–	–	–
Bermuda	–	–	–	–	–	1	2
Brazil	1	–	–	–	–	–	4
Bulgaria	–	–	–	–	–	–	–
Cape Breton	–	–	–	1	–	–	–
Central America	1	–	–	–	–	–	–
Chili	1	1	–	–	–	–	1
China	–	–	–	–	–	–	1
Columbia	–	–	–	–	–	–	–
Cuba	3	2	1	1	–	–	1
Denmark	–	–	2	1	1	1	1
Dutch Guiana	–	–	–	1	1	–	–
England	2	2	2	4	1	3	3
France	–	1	1	1	2	4	1
Germany	–	–	1	1	1	2	1
Guatemala	–	–	–	–	–	–	–
Holland	–	–	–	–	–	–	–
Ireland	–	–	–	–	–	–	–
Jamaica	–	–	–	–	1	1	1
Japan	2	2	–	1	2	2	2
Mexico	1	3	6	7	7	7	7
New Brunswick	1	2	2	3	3	2	2
New South Wales	1	–	–	–	–	–	–
Nova Scotia	2	1	1	2	–	2	6
Ontario	2	2	–	–	–	–	1
Peru	–	–	–	–	–	–	–
Porto Rico	1	–	–	–	–	–	1
Quebec	2	2	2	1	3	4	2
Russia	–	–	–	–	1	1	1
Scotland	–	–	–	–	–	–	–
Spain	1	–	–	–	–	–	–
Trinidad	–	–	–	–	–	–	–
Turkey	3	1	3	3	3	3	1
Venezuela	1	1	–	–	–	–	–
Total	1,187	1,198	1,198	1,171	1,178	1,277	1,415

Residence of Massachusetts Students.

It has been said that 59.2 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and thirty-four cities and towns are on the lists. The first column of the following table shows the number of cities

and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and forty-six, and Suffolk two hundred and forty-four pupils; Essex comes third, with one hundred and twenty-nine; Norfolk, fourth, with eighty-four.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	7	Middlesex	31	246
Berkshire	3	3	Nantucket	1	1
Bristol	10	27	Norfolk	19	84
Essex	23	128	Plymouth	15	44
Franklin	5	9	Suffolk	4	244
Hampden	3	16	Worcester	13	25
Hampshire	3	3			
			Total	134	837

The following is a list of the towns, fifty-nine in number, which send five or more students to the Institute:—

Boston	227	Waltham	11	Marlboro	7
Newton	49	Arlington	10	Winchester	7
Cambridge	31	Medford	10	Dedham	6
Newburyport	25	Melrose	10	Middleboro	6
Brookline	23	Springfield	10	New Bedford	6
Salem	23	Taunton	10	Wellesley	6
Somerville	21	Hyde Park	9	Belmont	5
Lawrence	18	Framingham	8	Concord	5
Lowell	18	Gloucester	8	Greenfield	5
Lynn	17	Quincy	8	Holyoke	5
Brockton	13	Canton	7	Stoneham	5
Chelsea	12	Fitchburg	7	Wakefield	5
Malden	11	Haverhill	7	Weymouth	5

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the catalogue of the year preceding; and, secondly, those whose names appear first upon the catalogue of the year to which the statement relates:—

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175

Ages of Students.

The next table exhibits the ages of our students upon entrance, after taking out two who are repeating the first year, and seventeen persons of unusual ages. These deductions leave three hundred and seventy-seven as the number of students whose ages have been made the subject of computation.

Period of Life.	1900–1901.		1901–1902.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	—	—
16½ to 17 "	4	5	4	4
17 to 17½ "	10	—	28	—
17½ to 18 "	41	51	48	76
18 to 18½ "	53	—	47	—
18½ to 19 "	65	118	66	113
19 to 19½ "	55	—	73	—
19½ to 20 "	30	85	41	114
20 to 20½ "	25	—	31	—
20½ to 21 "	18	43	24	55
21 to 22 "	7	7	15	15
	309	309	377	377

The results appear in the table above in comparison with the corresponding results of 1900–1901.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and ninety-two members of the class were distributed among the different periods of life as follows: —

Under 20½	—
Between 20½ and 21	2
" 21 " 21½	6
" 21½ " 22	13
" 22 " 23	54
" 23 " 24	53
" 24 and over	62
Total	192

The special students this year constitute twenty-nine per cent. of the whole body, as against twenty-seven per cent. last year and twenty-six per cent. the year before.

Graduate Students.

The number of students who are graduates of this and other institutions is one hundred and twenty-two. Of these sixteen are our own graduates, nine being candidates for advanced degrees.

One hundred and six are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Thirteen are graduates of Harvard University; six of Yale University; four each, of Amherst College and Brown University; three each, from Columbia and Johns Hopkins Universities and the United States Naval Academy; two each, of Boston, Chicago, Southwestern Presbyterian, Virginia, and Wisconsin Universities, Boston, Christian Brothers, Colby, Davidson, Mt. Holyoke, Neuchâtel, Smith, and Texas Agricultural and Mechanical Colleges; one each, of Acadia, Alabama, Baylor, Cambridge,

Catholic University of America, Cornell, California, Denison, Illinois, Lincoln, Nebraska, Northwestern, Rochester, South, Washington, and Washington and Lee Universities, and of Acadia, Augustana, Beloit, Bowdoin, Canisius, Central, Connecticut Agricultural, Detroit, Earlham, Gallaudet, Grove City, Iowa State, Mt. Alison, the Michigan College of Mines, Oberlin, Pomona, Pennsylvania State, Randolph-Macon, St. Joseph's, St. Ignatius, St. Xavier, Trinity, Tufts, Vassar, Villanova, Wellesley, and Williams Colleges.

Women Students.

The number of women pursuing courses with us is forty-nine. Of these five are graduates of colleges. Of the total number, five are regular students of the fourth year, six of the third year, five of the second year. Thirty-three are special students. Of the sixteen regular students of the upper classes, five take Course IV., Architecture; five, Course V., Chemistry; three, Course VII., Biology; two, Course VIII., Physics; and one, Course IX., General Studies. Of the special students, fourteen devote themselves to biology, four to chemistry, four to general studies, two to physics, one to naval architecture, one to geology, and four to architecture, while three are first-year specials.

Statistics of Admission.

Of the 1,415 students of the present year, 571 were not connected with the school in 1900–1901. Of these 358 were admitted as regular students of the first year upon the basis of their entrance examinations. The 213 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade or from the College

Examination Board. In addition to the 358 who were thus admitted to the first year on examination, and have taken their place in the school, 70 were admitted on examination, but have not entered the school.

In the case of the 358 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	264
" on one condition	70
" on two conditions	22
" on more than two conditions	2
	358

Fifty-three applicants were rejected.

Entrance Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Austin (Tex.), Baltimore, Belmont, Binghamton (N.Y.), Buffalo, Chapel Hill (N.C.), Chicago, Cincinnati, Denver, Detroit, Exeter (N.H.), Indianapolis, Kansas City (Mo.), Lead (S.D.), Louisville, New York, North Adams, Philadelphia, Pittsburg, Portland (Ore.), Portland, (Me.), Pottstown, Rochester, St. Louis, St. Paul, Springfield (Mass.), Syracuse, and Washington, and also in London (England).

Graduates by Courses.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	1	2	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	25	34	10	24	17	–	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	–	33	3	4	6	9	3	–	7	200
1899	30	38	9	22	21	–	32	2	2	1	9	1	–	8	173*
1900	32	33	20	21	16	–	22	3	3	5	11	4	–	9	184
1901	37	39	17	21	17	–	25	1	1	6	14	4	1	16	199†
Totals	474	560	201	218	277	1	431	40	36	85	104	33	9	59	2,532
Deduct names counted twice															14
Net total															2,518

* Deducting names counted twice.

† Including two persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir,— On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1900, to May 16, 1901.

The first meeting of the society for the present year was held on October 11, 1900, attendance being one hundred and forty-three. This shows a considerable gain over last year.

The following papers have been read: —

"Color Photography." PROFESSOR LOUIS DERR.

"Some Experiments on Architectural Acoustics." PROFESSOR WALLACE C. SABINE.

"America's Contribution to our Knowledge of the Size and Figure of the Earth." DR. HENRY S. PRITCHETT.

"Applied Science in the Textile World." PRINCIPAL W. W. CROSBY.

"Landscape Architecture in this Country." MR. GUY LOWELL.

"Shipment of Freights to Europe." MR. WILLIAM H. LINCOLN.

"Photography with the Great Visual Telescope of the Yerkes Observatory." PROFESSOR GEORGE E. HALE.

"The Designing of the Buffalo Exposition." MR. ROBERT S. PEABODY.

"A Forest Policy for the United States." MR. GIFFORD PINCHOT.

"The Use of the Microscope in the Study of the Chemical Constitution and Physical Properties of Metals." DR. HENRY FAY.

"Electrical Wave Transmission." PROFESSOR M. I. PUPIN.

"The Increase of the Food Supply of Mankind through the Cultivation of Marine Animals: A Problem in Economic Zoölogy." DR. GEORGE W. FIELD.

"Principles of Action of Various Types of Refrigerating Machines." PROFESSOR J. E. DENTON.

"Cotton from Seed to Bale." MR. HENRY G. KITTREDGE.

At the beginning of the year the Associate Membership was three hundred and ninety-nine. Of this number one has died, nine resigned, twenty-six have, however, been elected, making the present membership three hundred and fifty-six.

During the year the society has suffered the loss of one of its oldest members, Mr. Thomas Gaffield, who served on the Executive Committee from 1879 to 1883. Mr. Gaffield's interests were not confined to the welfare of the Society of Arts alone, but were extended also to that of the Institute, as evinced by his gift of books, specimens of glass and minerals to the Departments of Geology and Chemistry. At the time of his death he was a member of the Corporation of the Institute.

No change has occurred in the management of the *Technology Quarterly*. Since the last annual report twenty-five articles have been published in the *Quarterly*. Probably the most notable article is one on the Eclipse Expedition of the Massachusetts Institute of Technology to Washington, Ga., under the direction of Professor Alfred E. Burton. Illustrating this article is an excellent photogravure reproduction of one of the best photographs of the sun's corona that has ever been taken. This article has been followed by one from Rev. Professor William F. Rigge, S.J., who also observed the eclipse at Washington, Ga., being in charge of a party from Creighton University, Nebraska. In this paper Professor Rigge makes an interesting comparison between his results and those obtained by the party from the Institute, all of which redounds to the credit of both parties. Professor W. O. Crosby has contributed two articles giving the results of his explorations of the sites of proposed water supplies for New York and Brooklyn.

A gratifying instance of the loyalty of our alumni is furnished by the frequency of the contributions of two graduates of the Institute, Messrs. George C. Whipple and Daniel D. Jackson. They are actively engaged in an investigation of problems connected with the biology and physi-

cal characters of the water supplies of towns, and have contributed four articles on different branches of this subject.

Among other articles from the Physical Department, are an account of a series of tests made by Professor Norton on Fire Retardent Materials, and a series on diffusing glass of various kinds used in windows; and from Mr. W. Lincoln Smith an account of an extensive series of Tests of Certain Shades and Globes for Electric Lights as used in Interior Illumination. From the Mechanical Engineering Department the usual annual contribution of Results of Tests made in the Engineering Laboratories was published in the September issue. Professor Fay and Mr. Badlam contributed an important article on the Effect of Annealing upon the Physical Properties and the Microstructure of a Low Carbon Steel; and the Review of American Chemical Research, contributed by a number of members of the Chemical Department, has appeared regularly in each issue. Beginning with the current volume, a change has been made in the paper used in printing the *Quarterly*; and it is hoped that some saving of expense will result.

At the last meeting of the year the thirty-ninth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Charles T. Main, and James P. Munroe were re-elected members of the Executive Committee, and Mr. George V. Wendell was re-elected Secretary for the year 1901–1902.

Respectfully submitted,

GEORGE V. WENDELL,
Secretary.

DECEMBER 4, 1901.

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GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1901

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1901.

There has been a large increase in the amount received from students' fees, the total this year being about $21,000 greater than last year; but this has been offset by an increase in the amount paid for salaries, for labor, for general expenses, for fuel, for department supplies and other items, so that the net result is an excess of expenditure over income to the amount of $9,590.26,— a deficit about $1,000 greater than last year.

The following legacies and gifts have been received:—

Through the generosity of W. Austin Wadsworth, Esq., and Herbert Wadsworth, Esq., $20,000 has been added to the Edward Austin Fund. From the estate of the late Robert C. Billings has come a legacy of $50,000 for scholarship purposes. $1,655.45 has been added to the Susan E. Dorr Fund. $10,000 for scholarship purposes has been received from the estate of the late Henry Saltonstall, and $40,000 more as a fund for general purposes. $5,000 has been added to the Henry L. Pierce Fund. $1,000 was left to the Institute by the late Miss Rebecca A. Goddard. Mr. George A. Gardner has contributed $10,000 toward the new Electrical Engineering Building. A legacy of $2,000 has come from the estate of the late Barthold Schlesinger. A gift of $2,000 has been made by our ex-President, James M. Crafts. $1,114.62 has been received from the estate of the late John M. Forbes, and $500 from the estate of the late Sarah H. Forbes. Francis Blake, Esq., has contributed $500 for the purchase of apparatus for the physical department, and another friend has given $500 for certain special purposes. Mrs. William B. Rogers gave $400 for periodicals; Mr. Charles C. Jackson, $300 for general purposes; and $153.53 has been added to the Samuel E. Sawyer Fund.

The result is an increase of $99,808.46 in the property held for special purposes, and an increase of $48,000 in that for general purposes; and the net increase in the Institute's property, after deducting the excess of expenditure for the year, and certain other items, is $116,658.04.

Looking back ten years, we find that during that time the receipts from students' fees and scholarships have increased about $60,000, but during the same period the expenditures have increased nearly $139,000. This has been due in great part to the increased number of students, and to the increased demands for more advanced and more varied educational opportunities. The development of technical work and education has made necessary an amount of instruction and of laboratory apparatus far greater than that which sufficed ten years ago.

The gifts to the Institute during this period have been very generous, so that its total property has increased from $1,364,684.98 to $3,456,099.46, of which sum, however, nearly $1,400,000 is in real estate used by the Institute itself, and on the balance a much lower rate of return must now be accepted than that which was received ten years ago. In considering these amounts, the public must bear in mind that a very large proportion of this property is held for special purposes,— notably, scholarships; and such funds, while doing a most beneficent work for the students, do not enable

the Institute to meet its general expenses, since the expense of each student is considerably greater than what he pays. To raise the fees would carry them much beyond those charged in other educational institutions, and would, moreover, bear very hardly on a class of men whose work is of such high order as to entitle them to consideration both from the Institute and from the public.

Judging from the figures for this year, the increase in the number of students in the near future is likely to be very large; and there is imperative need of a large increase in funds to provide the necessary buildings and the necessary instruction.

The poverty of the Institute is the result of the excellence of its work and the reputation which it has attained. The alumni have shown a most loyal interest by contributing $100,000 toward the Walker Memorial Building, of which sum $30,000 has been already paid, but the number of Institute graduates who have been long enough at work to enable them to contribute largely to the support of the Institute is comparatively small, and it is necessary to rely still upon the generosity of the general public to enable the Institute to accomplish for the community the splendid possibilities that are opening before it.

SECURITIES SOLD OR PAID, GENERAL ACCOUNT.

$24,000	Walter Baker Co., Ltd., 4½s	$24,000.00
50,000	Ch. Junc. & U. S. Yards Inc. 5s	50,000.00
	House, 34 Commonwealth Ave.	28,681.00
50	Rights Ch., Mil. & St. Paul R.R.	225.00
		$102,906.00

SECURITIES BOUGHT OR RECEIVED AS LEGACIES, GENERAL ACCOUNT.

$50,000	K. C., Fort Scott & Memphis R.R. 6s	1928	$59,640.00
50,000	Long Island R.R. 4s	1949	49,500.00
25,000	Southern Rwy. St. Louis Div. 4s	1951	24,875.00
25,000	Ozark Equipment Co. 5s	1910	25,000.00
			$159,015.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 29, 1900		37,831.70
From Augustus Lowell for Lowell Courses	5,756.10	
" " " " C. Kastner's salary	1,458.31	
" " " " School of Design	500.00	7,714.41

RECEIPTS FOR CURRENT EXPENSES.

Income of funds for salaries	4,314.00	
" " " " scholarships (students' fees)	9,718.63	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	512.50	
" " " " Library	480.00	
" " " " general purposes	24,889.57	
" " Rogers Memorial Fund	10,853.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	6,725.00	
" " " " " Awards	3,856.55	
" " Teachers' Fund	1,200.00	
Letter Box Fund	81.37	
Students' fees	221,583.00	
State scholarships	4,000.00	
United States Act of 1862	5,468.34	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	10,844.99	
Rents, per Table (page 12)	8,729.93	
Gifts	4,814.62	
Interest	8,578.37	
Boston University	1,150.00	
Sale Printed Lecture Notes	2,805.30	367,833.66

GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.

Increase Scholarship Funds	881.03	
" Teachers' Fund	2,800.00	
" Edward Austin Fund (add'l $20,000)	23,818.45	
" Susan E. Dorr Fund, additional	1,655.45	
Electrical Engineering Building Fund	10,000.00	
Henry Saltonstall Scholarship Fund	10,000.00	
Billings Student Fund	50,000.00	
Samuel E. Sawyer Fund, additional	153.53	
Sarah H. Forbes Fund,	500.00	99,808.46

GIFTS AND BEQUESTS FOR GENERAL PURPOSES.

Henry L. Pierce Legacy, additional	5,000.00	
Saltonstall Fund	40,000.00	
Rebecca A. Goddard Legacy	1,000.00	
Barthold Schlesinger "	2,000.00	48,000.00

SECURITIES SOLD OR PAID.

General Fund, page 3	102,906.00

SUNDRIES.

Income credited to Bond Premium Acc't	3,585.00	
" " " Rogers Bond Premium Acc't,	810.00	
Boston Art Students' Association, on acc't	666.66	
Students' Notes paid	65.00	
Walker Memorial Fund	30,600.00	35,726.66
		$699,820.89

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1901.

Cr.

Paid for Lowell Courses	5,756.10	
" " Charles Kastner's salary	1,458.31	
" " Expense Lowell School of Design	500.00	7,714.41

EXPENSES.

Salaries, per Table (page 12)	263,009.82	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	3,856.55	
Teachers' Fund, "	1,200.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (13)	9,381.28	
General Expenses, per Table (page 13)	19,331.55	
Fire Insurance	1,782.62	
Fuel	10,901.81	
Water	2,697.20	
Gas	1,917.72	
Electricity	2,039.27	
Printing and Advertising	6,254.45	
" Lecture Notes	3,330.01	
" Annual Catalogues and Reports	3,161.59	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (p. 12)	44,256.00	
" " paid from Gifts	499.50	
Society of Arts	796.71	
Pan-American Exposition	927.84	377,423.92

(Expenses more than Income, $9,590.26)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Account (page 3)	159,015.00
Walker Memorial Fund	31,788.33

SUNDRIES.

Letter Box, 1900, used	51.12	
Ann White Vose Scholarship Fund, 1900, used	7.67	
Susan E. Dorr " " "	182.37	
Notes Payable	20,000.00	
Notes Receivable	75,000.00	95,241.16
Cash balance, Sept. 30, 1901		28,638.07
		$699,820.89

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1901 :—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
3,800.00	Republican Valley R.R. 6s.	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s.	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00	
3,000.00	Chi., Mil. & St. Paul R.R. 7s.	1905	3,000.00	
	Advances to Bond Premium account		10,032.50	
	Bonds			249,415.00

INVESTMENTS, GENERAL ACCOUNT.

10,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	10,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	4,100.00	
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00	
3,000.00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s.	1915	8,000.00	
5,000.00	Dominion Coal Co. 1st 6s.	1913	5,000.00	
2,000.00	New England Tel. & Tel. Co. 6s.	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.	1905	2,000.00	
100,000.00	West End Street Ry. 4s.	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s.	1908	50,000.00	
66,000.00	Walter Baker Co., Ltd., 4½s.	1903	66,000.00	
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50	
120,000.00	Illinois Steel Co., non-conv. 5s.	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s.	1939	43,000.00	
100,000.00	Long Island R.R. 4s.	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s.	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s.	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s.	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s.	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00	
100,000.00	Chic. & W. Michigan R.R. 5s.	1921	100,000.00	
100,000.00	American Tel. & Tel. Co. 4s.	1929	99,875.00	
50,000.00	New England Tel. & Tel. Co. 4s.	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s.	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R. 6s.	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s.	1951	24,875.00	
25,000.00	Ozark Equipment Co. 5s.	1910	25,000.00	
	Advances to Bond Premium account		44,832.25	
	Bonds			$1,416,920.21
	Amount carried up			$1,666,335.21

Amount brought up $1,666,335.21

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	$156,789.84

Investment of the Joy Scholarship Fund.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	9,123.70

Investment Swett Scholarship Fund.

Massachusetts Hospital Life Insurance Co.	10,000.00

Amount carried up $1,842,248.75

Amount brought up			$1,842,248.75

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, A, Trinity Place,	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		259,050.00	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	1,399,403.35
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	37,183.80

SUNDRIES.

Notes Receivable	137,000.00	
Boston Art Students' Association	9,666.66	
Students' Notes	770.50	
Walker Memorial Fund	1,188.33	
Cash Balance, Sept. 30, 1901	28,638.07	177,263.56
		$3,456,099.46

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,764.40	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	676,850.21
Amount carried up		$676,850.21

Amount brought up		$676,850.21
The income of the following is used towards paying salaries: —		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology . .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,238.21	
James Savage "	13,978.72	
Susan H. Swett "	10,182.95	
William Barton Rogers Fund	10,666.24	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,342.57	
Charles Lewis Flint "	5,264.09	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,815.67	
William F. Huntington "	5,216.66	
T. Sterry Hunt "	3,225.32	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,748.22	
Ann White Dickinson "	40,618.19	
Dalton Grad. Chemical "	6,222.54	
Willard B. Perkins "	6,839.18	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	313,482.26
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund		37,378.78
Susan Upham Fund		1,297.64
Susan E. Dorr "		11,000.00
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		365,034.09
Teachers' "		103,800.00
Saltonstall "		40,200.00
MISCELLANEOUS.		
Students' Deposits	200.00	
Henry L. Pierce Legacy, 1898	800,000.00	
Robert C. Billings Legacy, 1900	92,500.00	
Rebecca A. Goddard " 1901	1,000.00	
Barthold Schlesinger " 1901	2,000.00	
Electrical Engineering Building Fund	10,000.00	
M. I. T. Stock Account	845,856.48	1,751,556.48
		$3,456,099.46

Comparative Statement of Funds, etc.

	Sept. 29, 1900.	Sept. 30, 1901.
Trusts for general purposes	676,696.68	676,850.21
" " Salaries	107,600.00	108,100.00
" " Scholarships	252,808.90	313,482.26
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,297.64	1,297.64
Susan E. Dorr "	9,526.92	11,000.00
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
John Foster Legacy	10,000.00	
Henry L. Pierce Legacy	795,000.00	800,000.00
John W. Carter "	6,250.00	
Robert C. Billings "	92,500.00	92,500.00
Saltonstall Fund		40,200.00
Electrical Engineering Building Fund		10,000.00
Rebecca A. Goddard Legacy		1,000.00
Barthold Schlesinger "		2,000.00
Edward Austin Fund	341,215.64	365,034.09
Teachers' Fund	101,000.00	103,800.00
Letter Box Fund	51.12	
Students' Deposits	200.00	200.00
Notes Payable	20,000.00	
M. I. T. Stock Account	840,515.74	845,856.48
	$3,339,441.42	$3,456,099.46
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4)	99,808.46	
Gifts and Bequests for General Purposes. (See page 4)	48,000.00	147,808.46
Less Funds of 1900, used	241.16	
" Expenses more than Income	9,590.26	
" Loss on Sale of House 34 Commonwealth Ave	1,319.00	
" Notes Payable, paid	20,000.00	31,150.42
		$116,658.04

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,314.00	From Dividends, Bank Stocks	1,009.40
" " Scholarships	10,110.96	" State Tax returned on Bank Stocks	258.81
" " " James Savage Fund	400.00	" Bonds	59,689.63
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,852.50
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,048.00
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	24,707.20		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	881.03		
" " Advances to Bond Premiums	3,585.00		
	$66,773.34		$66,773.34

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,853.00	Received Income from Railroad Bonds	11,663.00
Credited to Advances Bond Premiums	810.00		
	$11,663.00		$11,663.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Lowell School of Design	1,800.00	
Land and Building, Clarendon St., on account	2,500.00	
Use of Rooms and Gymnasium	932.90	
	8,732.90	
Less Tax and Repairs, Cambridge, net	2.97	$8,729.93

Department Supplies.

Chemistry	11,361.72	
Physics	7,595.58	
Mechanical Engineering	4,854.11	
Architecture	3,892.71	
Mining	3,451.59	
Civil Engineering	2,538.58	
Workshops	2,208.68	
Periodicals	1,920.00	
Applied Mechanics	1,328.09	
Biology	1,268.80	
English	1,195.47	
Geology	1,021.11	
Naval Architecture	684.09	
Modern Languages	322.97	
Military	240.89	
Mathematics	203.25	
Drawing	168.36	44,256.00

Salaries.

Instruction	209,191.14	
Administration	25,898.43	
Labor	27,920.25	$263,009.82

General Expense.

Telephone Service, Installing Stations, Rentals, Repairs, etc.		3,023.85	
Postage		3,000.08	
Sundries		2,973.14	
Stationery and Office Supplies		1,494.57	
Electrical Wiring, Lamps, etc.		1,250.04	
Furniture and Window Shades		1,111.23	
Janitors' Supplies		1,002.69	
Examinations		985.07	
Express		700.91	
Diplomas and Commissions		598.10	
Washing		562.51	
Engine Room Supplies:			
Oil	275.39		
Sundries	58.36		
Waste	55.25	389.00	
Library		292.26	
Ice		275.47	
Legal Fees		252.50	
Taxes' Sale, No. 34 Commonwealth Avenue		224.69	
Examination Books		201.16	
Graduation Exercises		191.30	
Gymnasium		184.20	
Glass		182.40	
Removing Ashes		131.30	
Lowell School of Design		125.44	
Street Watering		104.64	
U. S. Vaults		75.00	$19,331.55

Repairs.

Department Improvements:			
Physics		626.80	
Chemistry		468.84	
Mechanical Engineering		375.98	
Mining		286.24	
Workshops		273.18	
Civil Engineering		231.97	
Architecture		219.96	
Drawing		207.78	
English		135.11	
Naval Architecture		97.17	
Geology		60.10	
Biology		50.63	
Applied Mechanics		17.18	
Modern Languages		6.25	
Mathematics		3.88	3,061.07
Rogers Building			1,897.83
Walker "			1,171.18
Sundries			1,065.47
Engineering Building			758.52
Steam Fitting			727.50
Pierce Building			391.85
Gymnasium			202.67
Boiler and Power House			105.19
			$9,381.28

BOSTON, November 29, 1901.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1901, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN,
WILLIAM L. PUTNAM,
Members of the Auditing Committee.

BOSTON, November 29, 1901.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1901.

They are correct, payments duly vouched and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1901, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

BY THE

PRESIDENT AND TREASURER

DECEMBER 10, 1902

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BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1902

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 10, 1902

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Members of the Corporation.

President.

HENRY S. PRITCHETT.

Secretary.

FRANCIS H. WILLIAMS.

Treasurer.

GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.	THOMAS L. LIVERMORE.
HOWARD A. CARSON.	A. LAWRENCE ROTCH.
CHARLES I. PAINE.	JOHN R. FREEMAN.
CHARLES FAIRCHILD.	GEORGE A. GARDNER.
DAVID R. WHITNEY.	WILLIAM H. LINCOLN.
ALEXANDER S. WHEELER.	J. B. SEWALL.
JAMES P. TOLMAN.	CHARLES L. LOVERING.
HOWARD STOCKTON.	A. LAWRENCE LOWELL.
NATHANIEL THAYER.	JAMES P. MUNROE.
CHARLES F. CHOATE.	WILLIAM L. PUTNAM.
HIRAM F. MILLS.	CHARLES G. WELD.
PERCIVAL LOWELL.	EBEN S. DRAPER.
CHARLES MERRIAM	ROBERT S. PEABODY.
THORNTON K. LOTHROP.	ELIHU THOMSON.
CHARLES C. JACKSON.	ELLIOT C. LEE.
SAMUEL M. FELTON.	JAMES P. STEARNS.
DESMOND FITZGERALD.	LUCIUS TUTTLE.
SAMUEL CABOT.	FREDERICK P. FISH.
FRANCIS BLAKE.	FRANCIS L. HIGGINSON.
CHARLES W. HUBBARD.	CHARLES A. STONE.

On the Part of the Commonwealth.

His Excellency JOHN L. BATES, *Governor.*

Hon. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*

Hon. FRANK A. HILL, *Secretary of the Board of Education.*

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT, } *Ex Officiis.*
GEORGE WIGGLESWORTH. }
HOWARD STOCKTON. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
FREDERICK P. FISH.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE. EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

ROBERT S. PEABODY. ALEXANDER S. WHEELER.
A. LAWRENCE ROTCH. FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH.
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

FRANK A. HILL. A. LAWRENCE LOWELL.
CHARLES C. JACKSON. JAMES P. MUNROE.
J. B. SEWALL.

Department of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. CHARLES L. LOVERING.

Department of Biology.

JOHN R. FREEMAN. CHARLES G. WELD.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

PRESIDENT'S REPORT.

To the Members of the Corporation :—

The year which has passed since my last report has been one of great activity in all the directions in which the work of the Institute lies. The opening of the last term brought an incoming class of more than five hundred, an increase in registration so great as to make necessary the immediate consideration of certain questions to which I shall ask your attention in the course of this report.

Changes in the Corporation.

During the year two members of this body, Mr. Arthur T. Lyman and Mr. Eliot C. Clarke, have resigned on account of the pressure of other duties. One notable figure has passed from our group never to return, Professor and former President Runkle, who died on the 8th of July last not long after his appointment as professor emeritus. Professor Runkle was the last survivor in the Faculty of the group of men who originally formed the Institute. As teacher, as executive officer, and as member of this body he had been with the Institute since its birth, and his death takes away one strong and tender tie which linked us to the past.

I cannot avoid at this moment the mention of one other change which the year has brought. Mr. Alexander S. Wheeler, for twenty-five years a member of the Executive Committee, has found it necessary to give up the active duties which membership in that committee imposes. No truer friend and no wiser counsellor than he has served your body.

We have welcomed to membership with us three new members: Mr. Frederick P. Fish, Mr. Francis L. Higginson, and Mr. Charles A. Stone.

Changes of Faculty and Instructing Staff.

The appointment of Dr. Duncan as head of the new Department of Electrical Engineering is elsewhere referred to. Professor Tyler, who resumed teaching last year, has been appointed head of the Department of Mathematics. The death of Professor Runkle left vacant the Walker professorship of mathematics, to which Professor Osborne has been appointed. Professor W. H. Niles, head of the Department of Geology, after thirty years of service to the Institute, tendered his resignation during the latter part of last year. In accepting it the Executive Committee spread upon its records an expression of its appreciation of his long and faithful service, and conferred upon him the title Professor Emeritus. He still remains, therefore, a member of the Faculty.

During the year the Corporation has elected two non-resident professors. This title has been given to men of distinguished attainments who, while not being bound to the full duties of a professor, nevertheless give courses of instruction. Under this arrangement Mr. Elihu Thomson has been elected Non-resident Professor of Applied Electricity, and Mr. Percival Lowell, Director of the Lowell Observatory at Flagstaff, Arizona, has been elected Non-resident Professor of Astronomy.

Assistant Professors Crosby and Clifford have been promoted to associate professorships in the Departments of Geology and Electrical Engineering respectively. Dr. William H. Walker has been appointed Associate Professor of Industrial Chemistry. Dr. F. Jewett Moore, an instructor of last year, has been promoted to an assistant professorship in the Department of Chemistry, and Dr. James Locke has been newly appointed Assistant Professor of Analytical Chemistry.

Mr. Harrison W. Hayward, an assistant of last year in the Department of Mechanical Engineering, has been promoted to the rank of instructor.

Newly appointed instructors are Dr. George W. Field, in the Department of Biology; Dr. Charles N. Haskins and Mr. Ernest A. Miller in the Department of Mathematics; Mr. Frederick R. Kneeland in Chemistry, Dr. Hermann Kurrelmeyer in Modern Languages, and Mr. Charles Beardsley in Economics. Mr. Robert G. Valentine returns to the Institute this year after an absence of two years, as Instructor in English.

Instructors and assistants who have terminated their connection with the Institute are Messrs. C. M. Fosdick, F. B. Driscoll, and S. L. Wonson of the Department of Civil Engineering; James W. Smith and H. L. Kehl in Mechanical Engineering; John Boyle, Jr., W. W. Garrett and F. H. Sexton, in Mining Engineering; John W. Smith, F. E. Busby, R. W. Balcom, C. Ellis, E. P. Beckwith, and A. C. Davis in Chemistry; W. I. Bickford, F. W. Freeman, H. H. Kennedy and G. Le R. Mitchell in Physics; Miss Alice Loring in Architecture; C. W. Hodsdon and J. C. Woodsome in Mechanical Drawing; J. P. Sanborn in English; and J. A. Frizzell and W. S. Newell in Mechanic Arts and Naval Architecture respectively.

The following assistants have been appointed: Messrs. Allen L. Appleton and Charles F. Willard in Naval Architecture; Chauncey C. Batchelor in English; Dr. Lewis P. Chapin and Messrs. Samuel C. Lind, Benjamin G. Macintire, Champion H. Mathewson, Royal L. Wales, Herbert S. Walker, Francis C. Ware and Robert S. Williams in Chemistry; Arthur Elson, Arthur L. Goodrich, Charles W. Sawyer, and Willis H. Towne in Mechanical or Freehand Drawing; David L. Wing in Economics; Roy G. Burnham, Henry A. Ferrin, Archibald Gardner and Clarence D. Starr in Mechanical Engineering; Kenneth C. Grant, Walter S. Hanna and Arthur T. Nelson in Civil Engineering; Herbert L. Sherman

in Geology; Charles B. Hollis, Charles A. Sawyer, Jr., and Charles H. Sisson, in Mining Engineering and Metallurgy; William H. Reed in Modern Languages; and Clifford M. Swan, Newell C. Page, Fred C. Randall, Irving W. Reynolds, and Orlando S. Stockman, in Physics.

Reorganization of Administrative Work.

The beginning of the present term finds the Institute working under an organization more complete than that which has served it hitherto. The Secretary has for many years had charge of varied duties: not only has he done the work of the Secretary of the Faculty, but he has supervised the registration, the recording, and the work of consultation with students. With the growth of the Institute these duties had become too varied and pressing for one man to perform, and, with the approval of the Executive Committee, the present year has seen a new distribution of duties, by means of which the Secretary is now able to give his time in part to the supervision of the Mathematical Department, and in part to the general duties of administration. The work of registration and of recording has been assigned to other officers, while the general work of consultation with students and the supervision, in particular, of the entering class, has been assigned to a new officer, the Dean. The office of Dean is held by Professor Alfred E. Burton, a graduate of Bowdoin College in the Class of 1878, who has been for some years a professor in the Institute. The office of Registrar is held by Mr. Walter Humphreys, a graduate of the Institute in 1897, while the office of Recorder is held by Mr. O. F. Wells, already familiar with this work through his service in the Secretary's office. Under this arrangement not only is a separation of duties and a corresponding clearness of responsibility attained, but, in addition to this gain, it is made possible for the first-year class to receive as never before the direct attention of an administrative officer.

The needs of student life are being this year further met by the appointment of a Medical Adviser, who has office hours at the Institute twice a week, during which he may be consulted by any student without charge. The services of this officer have been gratefully accepted by the students, many of whom come to Boston as strangers, with no knowledge of medical authorities, and are therefore glad to avail themselves of the advice of a physician who knows from personal experience the problems of student life. The Executive Committee has appointed to this office Dr. Franklin W. White, a graduate of the Institute in the Class of 1890, and of the Harvard Medical School in the Class of 1896.

Some three months ago Mr. Albert M. Knight, who had for thirteen years faithfully served the Institute in the office of Bursar, resigned on account of ill health. He has been succeeded by Mr. F. H. Rand.

Gymnastics and Athletics.

The gymnasium maintained by the Institute, while not of the most modern construction, affords nevertheless full opportunities for exercise. The classes in gymnastics conducted by Dr. Skarstrom, the director of the gymnasium, have been well adapted to meet the physical needs of students. Any student may obtain in the gymnasium such medical advice as he needs and the means for healthful exercise. The gymnasium is under the general direction of the Dean.

For the last two years the athletic efforts of the students have been directed toward class contests rather than toward the more ambitious inter-college contests. After a full discussion by the students, inter-college foot-ball was given up, and the energy which had formerly gone into it was concentrated upon the freshman-sophomore contest, which forms the chief field event of the fall. Outside of this the athletic efforts of students have gone in the main toward the development of track athletics. This is a direction in which the individual

can work without great loss of time, and it seems on the whole the most available direction in which students of technical schools can enter into athletic competition.

Changes in Courses.

For some years members of the instructing staff have conducted summer courses, to which have been admitted both students of the Institute and those who expected to offer themselves for examination in the following autumn. Until the past summer the conduct of these courses has been a personal matter with the instructors, to whom the fees were turned over. A change from this plan was made this year, the Institute assuming charge of these courses and paying the salaries of the instructors. The change has in every way justified itself, from the standpoint both of expense and of service.

By vote of the Executive Committee, it has been decided to discontinue the Course in General Studies, at least in the form in which it is now offered. This course was intended to appeal, from its nature, to a large number of men, being a general rather than a technical course. This has not followed; and, while the work of the course itself and the training which students receive in it have commanded the highest approval, the course has during its existence appealed to but a small number.

No successor has been appointed as head of the Department of Geology, to succeed Professor Niles, whose retirement is earlier referred to, but the work is being conducted, under the general direction of Professor Crosby, by members of the department, with the co-operation of members of the Department of Geology at Harvard University. This co-operation has been effected in the main by the courtesy of the Harvard professors in undertaking courses of lectures and of recitations at the Institute, in part by the admission of Institute students to field courses jointly with Harvard

students, and in part by the admission of advanced students of the Institute to classes at Harvard. Under this co-operation the students of the Institute have enjoyed the opportunities for study offered by both the Institute and the University, and have been able to avail themselves of the instruction offered in the geological departments of both faculties.

The Lowell Laboratory of Electrical Engineering.

In a former report I have called attention to the generosity of two members of our Corporation, Mr. A. Lawrence Lowell, and Mr. Percival Lowell, and of their three sisters, Miss Amy Lowell, Mrs. William L. Putnam and Mrs. T. J. Bowlker in their gift of $50,000. for the purpose of a laboratory of electrical engineering. To this sum Mr. George A. Gardner, another member of the Corporation, added $10,000., Mrs. W. S. Fitz $2,000., and Mr. C. C. Jackson $3,000., making in all a sum of $65,000. In recognition of the great service rendered to the Institute by the late Mr. Augustus Lowell, the Corporation voted to give to the new laboratories his name.

The separation of the Department of Electrical Engineering from that of Physics was announced to your body last year. Last spring the Executive Committee called to the head of the new department Dr. Louis Duncan, some time professor of electrical engineering in Johns Hopkins University, and for some years past a practising engineer in New York City. Dr. Duncan has twice been elected President of the American Institute of Electrical Engineers, and comes to his work as head of our new department with an unusual experience and a thorough and varied training. In view of immediate needs the Executive Committee determined last year to erect on the Trinity Place land a building to serve for this department, and to provide at the same time additional class-rooms for other instruction. This building was begun in July and was pushed to completion with re-

markable rapidity during the summer vacation. It houses, in addition to the Department of Electrical Engineering, part of the work of the Department of Chemistry and the entire Department of Modern Languages. The building is, for the purposes of the Department of Electrical Engineering, almost ideal, and, when the equipment which has been purchased is in place, we shall have in Boston one of the most perfect and at the same time one of the most practical electrical laboratories in the world. The Institute has every reason to congratulate itself upon this step, and upon the prospect which opens before it for a unique contribution to the training of men for this great branch of modern engineering. It may be said in passing that the addition of the forty thousand square feet of laboratory and recitation rooms which this laboratory affords us came none too soon. With the entrance of the freshman class this year, the Institute found its facilities taxed to the utmost, and without this building it would have been almost helpless.

Graduate School of Engineering Research.

Upon the recommendation of the President and Faculty the Executive Committee has determined to inaugurate, with the beginning of the next academic year, a school of engineering research intended to provide facilities for a small number of advanced students who show capacity for original investigation.

While this addition to the work of the Institute is intended as a fitting crown to its structure, and while its purpose is to hold up before our students the idea of a higher professional life and the hope of direct contributions to the world's knowledge, it is also to be remembered that this step is a necessary one in our competition with the technical schools of other countries. The events of the past five years have served to draw attention most sharply to the connection between commercial and industrial advance and commercial and industrial

education. The world has awakened to the fact that education and training in the end outstrip natural ability and untrained initiative, and the civilized nations of the world are bending their energies, in proportion as they are alert, to the problems of technical education. We in America must keep step with the needs of our own country and the efforts of other countries in this direction, and the time has now come when the American engineer must be capable, not only of the most modern practice, but also of conducting investigation and research. To show how clearly our work in this direction is watched and followed, I venture to quote from the inaugural address of the present Rector of the great technical school at Charlottenberg.

"The German need fear in the industrial world neither the Englishman nor the Frenchman, only the American; and to compete with the American engineer, we must strive constantly to improve and extend our engineering courses."

The time has come when the Institute must be not only a teaching body, but it must as well lay the foundations for a school of investigation in the physical sciences. To do this it must establish the conditions which foster that quiet spirit of research upon which all advance and all discovery rest.

Publications of the Institute.

In another part of this report will be found a list of papers and books — in most cases technical — published during the year by members of the instructing staff. The current publications, the Catalogue, the Department Circulars, the Technology Quarterly and the Technology Review have been issued in the usual manner. The Review contains in an interesting and complete form the news of the year, appropriate space being devoted to the discussion of such questions as arise in the conduct of the work itself. It is hoped that

members of the Corporation and of the Alumni may find here an interesting and satisfactory means of keeping in touch with the work of the Institute.

The Increase in Tuition Fee.

The Corporation, since my last report, has voted to raise the annual tuition fee from $200. to $250., this advance to take effect with students entering in September, 1903.

Two distinct plans for providing higher education have been adopted in the various states of the Union. In the great Western States the State University, built and maintained by the people of the whole state, offers the facilities of the college and of the technical school without payment of tuition fee. In our Eastern institutions the state has furnished but a small part of the money necessary to build and maintain colleges and technical schools. These institutions have been in the main founded by private citizens, and are maintained in part by endowment, also the outcome of private generosity, and in part by tuition fees paid by students. Whether the plan of free tuition be the better or not, it would seem practically certain that colleges in New England must depend to a greater or less extent upon tuition fees.

In no institution does the student pay the full cost of his education. The actual cost per student which any college will be called upon to bear will depend upon several factors: the number of students, the facilities offered, and the number and excellence of the instructing staff. In a technical school not only is the expense per student greater than in academic education, but growth of numbers means a far greater growth of expense as compared with college expenses, for such growth means increase in laboratories, expensive to their first cost and expensive to maintain, and it involves a far greater increase in instructing staff than in the case of the teaching of Latin or Greek or history.

The Institute of Technology has but a small endowment in comparison with the larger universities. In addition, a large part of its trust funds is devoted to scholarships, and, as each student costs much more than the amount of tuition, every gift for scholarship purposes increases the load which the endowment carries.

In view of these considerations it has seemed wise to increase the tuition. It is believed that, with a larger grant than heretofore from the Austin Fund for scholarships, this increase will not impose upon students of small means greater difficulties than now present themselves. The annual fee, even with this increase, is still far below the average cost to the Institute for each student.

In comparison with the cost of the ordinary college education it is to be remembered that the technical school not only expends upon each student a much larger sum than the college, but it is also true that the graduate of the college must still prepare himself for a profession after completing his college course, while the graduate of the technical school finds himself in possession of a training which commands an immediate remuneration. For some years the demand for graduates of the Institute has been far in excess of the number of graduates. The value of its diploma will be greater for each graduate in just such measure as its instruction and its facilities are keeping abreast of progress and are in position to profit by all advances.

State Aid to Higher Education.

The difference in the method by which higher education is maintained in the older states of the Union and that adopted in the newer states of the West has already been alluded to. Perhaps few appreciate, however, the difference of cost thereby thrown upon the individual student in the effort to obtain an education.

The University of Michigan, for the year 1901–2, had a

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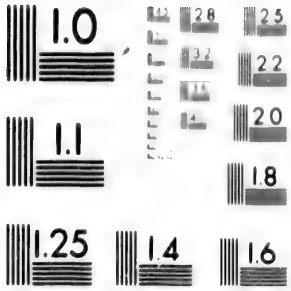

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registration of 3,509 students, exclusive of those in the summer school. Of these 2,052 were from the state of Michigan, each of whom paid an annual tuition fee of from $30. to $35. The remaining 1,456 were from other states and territories and from foreign countries. Each of these paid from $40. to $45. annual tuition fee. A matriculation fee of $10. is paid upon entrance. The entire student body of 3,509 students paid into the University treasury tuition and matriculation fees to the amount of $148,515. During the same year 1,415 students in the Institute of Technology paid tuition fees to the amount of $253,000. The difference in the cost to the individual student was made possible by the fact that the University of Michigan received from the state, for the expenses of that year, a contribution of $450,000. Counting interest at 4 per cent. this income is equivalent to that arising from an endowment of more than eleven millions of dollars.

Purchase of Land in Brookline.

During last spring, under the authority granted by the Corporation, the Executive Committee purchased a tract of land, consisting of about twelve acres, in Brookline, in a most attractive region, within easy reach of Jamaica Pond. This purchase was brought about by several considerations, but it was due in the main to the generosity of a member of this Corporation, Mr. Samuel Cabot, who made a gift to the Institute of his share in the property, a gift of the value of some twenty thousand dollars. The Executive Committee was influenced, furthermore, by the fact that this was almost the only remaining piece of land in this region which could be acquired for a reasonable sum, and it was felt that, with the growing needs of the Institute, a use for it would readily be found. A study of the land for the purposes of a student community is now being made.

The Pressure of Increasing Numbers.

Elsewhere, in the statistical part of this report, is given the customary information which is collected from year to year concerning the membership of the student body. I quote from these data the figures which give the registration for the past four years.

1899–1900	1,178
1900–1901	1,277
1901–1902	1,415
1902–1903	1,608

An inspection of these figures shows that the registration of the Institute has increased by more than four hundred in three years, an increase of approximately thirty-five per cent. A further inspection of this registration brings to light several other interesting facts. The distribution of the students of the Institute is very wide. Students are attracted not only from all parts of the Union, but from some twenty foreign countries; and it is particularly interesting to find amongst these numbers a growing attendance from the West and South. One cannot but feel that the bringing together of students from all states is a contribution, not alone to technical education, but to national strength and citizenship as well.

Another interesting and suggestive characteristic of our registration is the increasing number of men who come to us for a technical training after having already received a college education. Approximately one hundred and fifty men enrolled as students at the Institute hold the Bachelor's degree, either of Arts or of Science. The increase in the number of such students is most gratifying. As I have formerly pointed out, the presence of students from outside the United States and from distant states is, perhaps, the best barometer we have for measuring our own standards of work; but from another standpoint, this great growth of registration brings the Corporation face to face with a most serious admin-

istrative problem. Notwithstanding the increase in tuition, the preliminary examinations for next year indicate an entering class in 1903 as large as that of the present year. Upon such growth certain fair limitations, which the Faculty will doubtless impose, may be placed by a more strict scrutiny of the examination papers; but such restriction as this may in the end have no marked effect upon the attendance, for the rejection of weaker men will continually make the Institute more attractive to the stronger men. While certain causes, such as industrial depression, might temporarily stop the growth of the Institute, there seems no reason to doubt that we may expect, under ordinary conditions, a fairly regular increase in our numbers.

How serious a problem this is may be judged from the statement which I have made in saying that without the addition of the Lowell Laboratory of Electrical Engineering, which was made ready by an unusual effort, the Institute would have been unable, this year, to deal efficiently with the students who came to it. With any continuance of such growth as we have experienced it is absolutely necessary that larger quarters and additional room be furnished within the next two years. At the present time the Institute has at its disposal, not covered with buildings, about 20,000 square feet of land on Trinity Place and 25,000 square feet on Garrison Street. In addition it has the Grundman Studio building on Clarendon Street, which could on the expiration of the present lease be torn down, and which covers a space of 23,280 feet, in all approximately 70,000 square feet. It is evident that these small tracts of land afford no permanent or adequate relief for the development of the immediate future, nor do they solve the difficulty which comes from the overcrowding of the Rogers and Walker Buildings. This question is one which is before you for decision, and at the earliest practicable date. Shall we fit the life and the growth of the school to its present quarters, or shall we find for it a site where it may have room for such growth as it may normally and naturally expect?

The Limitation of Numbers.

The idea has been more than once brought forward that an arbitrary limit should be set to the number of undergraduate students admitted to the Institute, and the plan has long been in force in certain foreign schools of high standing.

While it is desirable to impose conditions of stricter scrutiny upon candidates for admission, so as to keep out those who are intellectually and physically weak, or who are insufficiently prepared, I should be sorry to see arbitrary limitations placed upon incoming students who are well qualified for our work, whether those limitations come in the form of high tuition or in the form of limitation of the number of students. In a growing country, where a continually enlarging demand for technical education will as a matter of course send an increasing number of students into the technical schools, a steady growth in numbers is a natural feature of institutional development. The technical school may well share with the country itself the problem of meeting the demands which a growing constituency implies.

There is, however, another consideration constantly to be kept in mind, and that is the relation of numbers to efficiency. If increase in the number of students is to mean decrease in the efficiency of instruction, then every increase above the point of maximum efficiency is a positive wrong to the students themselves, and will in the end bring down the standard of instruction. Is it possible to allow numbers to increase without any other restriction than those imposed by the requirement of thorough preparation, and yet keep up the standard of instruction or advance it?

I have no hesitation in saying that the problem of maintaining and of improving the efficiency of instruction in technical studies in the face of a growing registration is purely one of administration and of income. A department of civil engineering, for example, with a registration of three hundred students, can be as effectively conducted as a department in

which the registration is only one hundred, but the organization must be fitted to the problem. In the latter case the head of the department will give a large part of the instruction, while in the first he will give only enough to keep in touch with the work, and he will occupy himself in large measure with the administration of the department. But this is only part of the problem. There will be certain subjects in which one man may lecture to three hundred students quite as effectively as to one hundred; but there will be other subjects where one man can teach effectively, thirty, seventy-five or one hundred students, as the case may be, and in these subjects students must be taught in such sections as experience has shown to be effective, and the instructing staff must be increased to meet the new organization. Thus, if the number of students in bridge design becomes too large to be effectively served by one teacher, a second must be provided, and this must not be a young assistant or instructor, but another professor of equal standing with the first.

It is at this point that the dilution of instruction generally begins. As numbers grow, two methods are ordinarily adopted in institutions of learning to meet the demands of the growing classes. The first device is to form the class into a larger number of sections and impose upon a professor who is already working nearly to the limit the heart-breaking task of teaching the same subject two, or even three, times daily to different groups of students. There is no quicker means of killing the enthusiasm of a teacher than to harness him to this sort of intellectual treadmill.

The other method of dealing with the problem is to appoint an additional assistant or instructor. This is better than the first, and, if the assistant or instructor proves to be an able and efficient man, it may solve the problem in many cases. But in certain subjects the work can be done only by a man of experience and of ripe knowledge, and in such cases the institution should face the problem squarely and add to its staff two or three or four professors in the same subject, until

the point of highest efficiency is reached. It goes without saying that such increase in instructing staff carries with it some increase in laboratories, in drawing-rooms, in lecture rooms, and in similar facilities. For, even when the additional professor is secured, he must have a place in which to work, and this in accordance with a feasible scheme of hours and rooms.

Still the essential fact remains that the real limit of the work of an institution is not to be found in the number of its students, but lies rather in the limitations of its administration, of its instructing staff, or of its facilities. If these are made to keep pace with the growth in numbers, the quality of instruction may not only be maintained, but it may be continually advanced. The institution, however, which enters upon such a policy should face the whole situation, it should strengthen its instructing staff to keep pace with its student growth, and should so plan its buildings and its laboratories that they may be expanded with expanding needs.

In closing my reference to this subject, I wish to call attention to the fact that the institution which is large enough to require the services of several teachers in the same technical branch and has resources sufficient to secure men of high quality has a marked advantage in the very fact that a subject is being presented to students by more than one man. For some reason there has been in American colleges a great hesitation to start two men in the same institution upon parallel lines of instruction. Yet this feature of the German university is one of its sources of strength. The fact that the German student may choose not only his subject but his teacher in that subject is a powerful stimulus to good work, and forms one of the influences whereby the competition which goes on in the German universities, instead of being as with us a competition between institutions — too often a competition along purely material lines,— becomes a competition between individuals in the noble rivalry of scholarship. There is no reason why we should not in our institutions avail our-

selves of this same means for quickening the intellectual life and for keeping alive the intellectual alertness of our teachers.

The Problem of the Institute's Location.

As I have already pointed out, the Institute has at command about 70,000 square feet of land upon which it may build. This is wholly inadequate to serve as a basis of development for the future. To purchase additional land adjoining our present site seems to me not only beyond our means, but undesirable as well. It is essentially uneconomical for an institution of learning to occupy land having so high a commercial value.

The time has come, in my judgment, when we should ask the General Court to remove from the land which we own on Boylston Street the restrictions that were placed upon it in the act of gift. In case this is granted, we should then look about for a site of not less than thirty acres, which shall still be near enough to be in touch with the industrial life of the city, which shall be accessible from the various railroad stations, and where the Institute may develop in such way as the demands of the future clearly indicate.

For a discussion of the advantages and disadvantages of such a plan, I refer you to the July number of the *Technology Review*, which most of you have doubtless seen. The arguments on both sides are there summed up as follows.

"These, then, seem to be the seven main disadvantages resulting from a removal of the Institute from Copley Square to some region more distant from the city's centre: —

"1. The labor and controversy of an appeal to the General Court.

"2. A loss of the moral support due to sentiment.

"3. The giving up at least to a considerable degree, of its pre-eminence as the educational focus of Boston.

"4. At least a partial separation of the Institute from those industrial and mercantile interests which have been its main support, and from certain other educational agencies.

"5. Inconvenience of access, causing loss of time and increased expenditure on the part of the students.

"6. The many complications which must arise from the establishment of the residence system.

"7. An increased delay in providing much-needed new buildings."

"The main advantages in favor of removal may then be summed up as: —

"1. Increase of public interest through the conspicuousness of so radical a step.

"2. The possible creation of a new sentiment and affection for the Institute, stronger even than that already existing.

"3. The replanning of the buildings upon a more suitable and unified scheme.

"4. The better housing of the students, together with a supervision of their social life.

"5. Relief from the noise and disturbance inseparable from the present location.

"6. A segregation of buildings and increase in dignity that will make the greatness of the Institute's work more patent.

"7. Closer relations among the officers of instruction, and between them and the undergraduates."

To my thinking the arguments in favor of a transfer of the Institute to an accessible site greatly outweigh those against it. Not only is it true that the overcrowded condition of our buildings is becoming every year more of a source of weakness, that the loss of time in passing from one group of buildings to another is becoming more difficult to bear, but the inconvenience of sending 1600 students back and forth across a crowded highway like Boylston Street is causing each year an increasing loss of time. There is a general ground upon which the whole question rests, which seems to me still more worthy of consideration. It is this: the Institute of Technology exists, not simply as a school to train men for architecture or for engineering, but it exists also as a center of

intellectual and moral activity. As such it should exhibit in the conduct of its work the principles for which it stands. Thus, it has a school of architecture, ably conducted; its buildings ought to express architectural beauty and truth, while standing at the same time for academic simplicity. We maintain courses in heating and ventilation and sanitation, and we should show in the management of our own lecture rooms and laboratories the same principles which we teach. It is impossible to do this in the overcrowded condition of our present buildings.

The Increasing Cost of Student Life.

Over and above all other things, I believe the time has come, particularly in New England, when institutions of learning should set before the eyes of students their own ideals of a wholesome, democratic, and simple college life. Any student of the conditions of American college life can but be alarmed at the increasing sum which is required to send a boy through college; and it is time that some institution should deliberately set itself to work to solve the problem of setting forth a college life that should give to the poor student the opportunity of economical living, and at the same time the opportunity of social intercourse with his fellows. College life has been set at such a pace that the poor student is practically barred from participation in social life, unless he be, perhaps, an athlete and finds his expenses met by his athletic abilities, a state of affairs not wholly desirable. To my thinking there is no better problem to which the Institute can devote itself than to that of furnishing to its students such facilities as will make the student life economical and simple, yet attractive to rich and poor alike.

Should the Institute adopt a plan of removal, I hope that it may undertake to deal with this problem; and in order to do so a system of dormitories or student houses would need to be erected upon the new site. To accom-

plish the end in view, these dormitories or student houses must be maintained in a different way and upon a different principle from those ordinarily adopted. They must not be counted on as a source of revenue, but must be used to furnish the best means of living at little more than cost. I would suggest as an experimental plan some such arrangement as the following: two quadrangles, consisting of four buildings each, each quadrangle accommodating approximately five hundred students, the lower floor of each building to be devoted to sitting rooms and dining rooms, and the upper floors to bedrooms and occasional suites for those who desire more expensive quarters. I should call these houses rather than dormitories, as they will in their essential features be more akin to the English University Houses than to the American dormitories. Each house would form a union, its students meeting in the dining hall and for social intercourse. The entire group of houses would be lighted and heated by a central power plant, in which would be located the central kitchen, a refrigerator plant, and a laundry. With such a plant I believe we might successfully undertake to solve the problem of the economical housing and feeding of students. With proper system and with business methods, buying provisions at wholesale, I have no question but that we could offer the student lodging and food at prices far less than our students now pay for uncomfortable lodgings and for unsanitary food, with the additional advantage that the general mass of students would be thrown together under the influence of a simple and democratic social life.

I am satisfied that few appreciate the economic and hygienic waste which comes in the housing and feeding of a body of students taking up their work in a new and, to most of them, unknown city. Boston is an expensive place as American cities go. The student who comes here from a distant place, particularly if his means are limited, undertakes to house and feed himself as cheaply as possible. In his effort to do so he not only isolates himself from his fellows, but he

oftentimes finds himself in quarters which are morally and physically undesirable. A number of students eat unwholesome and insufficient food, and pay for it prices which, under such a plan as that I have outlined, would furnish wholesome and sufficient food. The entire lack of any plan for the housing and feeding of students involves a moral, economic, and social waste, and I know of no better problem with which an institution like this may deal than that of stopping this waste.

How much the economic waste alone amounts to in the matter of food may be judged from a comparison of the prices paid by our students with the cost of food for the West Point Cadets. The Cadets are, perhaps, the best fed student body in the world. Their meals are simple and wholesome, but are chosen from the best material that the market supplies, and they are cooked after modern sanitary methods. The cost of food and service amounts to but fifty cents a day per man, or $3.50 a week, which is just what the cheapest boarding houses charge Boston students for food far from satisfactory.

This question is worth considering, not only from the standpoint of the student and of his social and physical needs, but also from that of the educational interests of Boston and New England. Boston is not only interested in the work of education, it is interested also in the business of education, and it seeks to encourage by every right means the coming to it of men seeking education. Such exchange increases in the best way the ties which bind New England to the other states, ties which we desire in all ways to foster. Our New England institutions were begun and have prospered as private institutions, without large grants from the state, and they have therefore always been conducted on the theory that a fairly high charge for tuition could rightly be made. The great Western institutions, like those at Madison and Ann Arbor, have grown up under a different theory. In those states the Commonwealth itself undertakes to furnish a free

education of the most complete sort, and the state university forms the apex of the state educational system. The incomes of the state universities are growing year by year, and the facilities which they offer are rapidly becoming comparable with those offered by the strongest New England institutions. Tuition is free, or at most is but a nominal sum, living is cheap, and a student may go to one of these great Western institutions and live for a whole year for the sum required for his tuition alone at the Institute. All these considerations are making, as time goes on, stronger reasons why boys from Texas and California and Missouri and Georgia and other distant states should consider these institutions, rather than those of New England, as places of residence for their student life. Any intelligent plan under which the coming of the student to Boston may be made easier and less expensive, and particularly any plan which will free the stranger from the uncomfortable task of finding quarters in unknown surroundings, which will offer to the student of limited means an easy and direct choice of his student home, and which will make the problems of that home simple, will act as an offset to the considerations which I have mentioned, and will make easier the way of the student to a New England education. The man who can afford it will always come from distant states to New England, so long as our institutions maintain their high standing, so long as their faculties are composed of great teachers, and so long as their facilities are better than those of other regions; but the burden of a high tuition and of expensive living will become a continually increasing barrier, a sort of educational tariff, erected against the student of limited means. The son of the clergyman, of the teacher, of the clerk, of the man of small income, will find it each year harder to obtain an education from us, and will be forced by reason of the increasing cost to turn elsewhere.

An increasing number of students is being attracted each year from New England, from the states of New York and

Pennsylvania, and from the Southern states to the great universities of the central West. No true citizen of the Union regrets this. It will be a fortunate day for our country when the colleges of Louisiana and of the Carolinas are so strong in teachers and equipment as to attract students from Massachusetts and from New Hampshire. But I should be sorry to see the time come when the cost of education in Boston was so great as to limit the number of those who come to us from distant states to the families of the well-to-do, or to those who receive aid from the college endowment.

A member of the Executive Committee will present for your consideration a Memorial to the General Court, praying the removal of the restrictions upon the property of the Institute granted to it by the state in 1861; and this Memorial, if approved by you, will be presented to that body. Pending that action I ask you most earnestly to consider the question which I have presented to you.

Reports of the Departments and Statistics.

There are given in the following pages brief reports by the heads of the various departments, together with statistical information prepared in the office of the Registrar. The information contained in these reports is of the greatest interest, and I commend the statements and tables there presented to your careful inspection.

HENRY SMITH PRITCHETT,
President.

BOSTON, December 10, 1902.

REPORTS FROM THE DEPARTMENTS.

Courses I. and XI. Civil and Sanitary Engineering.

No changes have been made in the course of instruction other than some slight transfers of time made necessary by the rearrangement of the work in geology. The only changes in the force of instruction have been the substitution of three new assistants for three who left last year to engage in practical work. An additional assistant was authorized by the Corporation, but it was impossible to find any one for the position. We have, therefore, a smaller instructing force this year than last, owing to the retirement of Professor Burton from active participation in the work of surveying, of which he previously had charge. The capacity of our drawing rooms, moreover, is severely taxed.

Independent of the increased number of students, the department is seriously hampered by lack of room, on account of the necessity of enlarging the Engineering Library. This library is used by students in Civil and Mechanical Engineering and in Naval Architecture, in which three departments there are more than three hundred students in the upper classes. The library has but three tables available, seating about thirty-six students; while the number of books is increasing so rapidly that another bookcase is imperative, the installation of which will reduce the number of tables to two. In another year or two there will be practically no room in this library for readers. It should be so extended as to include the entire front of the Engineering Building, now occupied by the office of the head of the department and the model room, and additional space should be provided for the department in the Pierce Building. The space now occupied in

that building by the Chemical Department and by the second-year architectural drawing-room is the only space into which this department can expand, and such expansion will soon be necessary, unless the Engineering Library is to become a mere store-room for books.

There has been an even greater demand for our graduates this past year than before. Including the retiring assistants, forty men were available for positions last June. From May 1 to Nov. 1, applications were received for between one hundred and fifty and one hundred and sixty men, and such applications continue to be received almost daily.

The fifteenth session of the Summer School of the department was held during the past summer at Ellsworth, Me. Eleven students were in attendance. The school was in charge of Professor Burton, assisted by Professor Robbins, Professor Barton, Mr. Sweet and Mr. Hosmer, together with Mr. Nelson and Mr. Seabury of the class of 1902.

There was the usual field practice in base-line measurement and triangulation. On the triangulation was based a plane-table survey, the scale being 1 to 5000, with a contour interval of 10 feet. A tide gauge was set up, and a datum plane established as a basis for all levels. A profile was made of some four miles of the Union River valley, and hydraulic measurements were made by means of floats and meters to determine the discharge of this river. An interesting geological section was surveyed with transit and stadia. Astronomical observations were made for the determination of latitude, meridian, and time.

In order to connect the Ellsworth survey with the general system of triangulation of the Atlantic coast, the United States Coast and Geodetic Survey stations on Green Mountain and Blue Hill were occupied, and angles were measured to a new triangulation station in Ellsworth.

On July 2 a portion of the school made a trip to Nova Scotia, visiting the Joggins Coal Mines and fossil beds. On the return a stop was made at Moncton, N.B., and photographs were obtained of the tidal bore.

Course II. Mechanical Engineering.

Attention is again urged to the need for certain additional apparatus, which must be obtained if the laboratory is to continue to hold the position it has held in the past, both in view of the increasing number of students to be provided for, and to enable the department to pursue investigations along certain new lines of great importance from an engineering standpoint. The last addition of any considerable magnitude was made nearly three years ago. A small amount of apparatus is made at the Institute, but these additions are very limited in amount, and much time is required for their completion. An attempt is being made, however, to add to our equipment for testing cement in this way.

A valuable addition has been made to the apparatus of the laboratory in the form of a gift from the Westinghouse Air Brake Company consisting of an entire air brake equipment for a freight train consisting of a locomotive and twenty-five cars. This will make it possible to investigate practical and important questions concerning the working of air brakes.

The drawing-rooms are inadequate for the number of students. In order to accommodate those now taking this work, it will be necessary to substitute tables containing two drawers for those with one, and to assign two students to each table; and this will be necessary, not only throughout the entire room occupied by the second-year class, but also for a considerable portion of that occupied by the third-year class. Additional space will be absolutely essential next year.

During the past summer Professor E. F. Miller visited a large number of European Engineering Laboratories. His observations emphasize the importance, if we are to maintain our place in competition with the great technical schools of the world, of providing additional apparatus of considerable magnitude. Professor Miller's report will appear in an early number of the *Technology Review*.

The American Society of Mechanical Engineers held their spring meeting at the Institute in May, their opening session being held in Huntington Hall. At this meeting addresses of welcome were made by the President of the Institute and by the President of the Boston Society of Civil Engineers. The Society made its headquarters in the Engineering Buildings of the Institute, and the members of the Society visited and inspected the laboratories of the department. The attendance was larger than at any previous meeting, the members and guests present numbering nearly nine hundred.

The American Foundrymen's Association held a successful meeting at the Institute in June, during which the members paid a visit to the laboratories of the department.

In September an enthusiastic meeting of the National Association of Stationary Engineers was held in the rooms of the department, and its laboratories were visited by members of the Association. This meeting was the largest and most successful yet held by the Association, fourteen hundred and sixty-four members and guests being in attendance.

Course III. Mining Engineering and Metallurgy.

During the past year many minor changes have been made in the mining and metallurgical laboratories, as well as important additions to their equipment, all aiming at increased efficiency. Owing to the rapid growth of the department and the introduction of new subject-matter in the work of fourth-year students, there is a strongly felt need for additional space. Particularly is this true as regards the departmental library, which needs more room for additional book-cases and for reading tables.

The departmental library has been enriched by the addition of three complete sets of important periodicals, for one of which, the "Australian Mining Standard," it is indebted to Mr. G. M. Hyams.

The summer school of Mining Engineering was held in Nova Scotia and Cape Breton, thus affording a good opportunity to see the mining of gold and of coal, as well as the coking of coal, the smelting of iron, and the making of steel in open hearth furnaces. Gold mining was studied at Waverley, N.S., where the plant was turning out, stamping, amalgamating, and concentrating fifty tons a day. Visits were made for the study of coal mining to the Drummond Colliery at Westville, N.S., where the slope is about a mile deep, and the whole of the coal is taken out at one time by the use of timbers; later to the collieries of the Dominion Coal Company near Glace Bay, where the coal is mined in rooms, the pillars being removed later; and finally to North Sydney, where the coal has been mined by the pillar and stall method some two miles under the sea. A study was made of the smelting of iron at Ferrona, N.S., where pig iron is made for the steel works at Trenton from Newfoundland ore, and later at the extensive works of the Dominion Iron Company, Cape Breton, where the iron furnaces, steel furnaces and rolling mills are all placed systematically together. The kindness of those in charge of the various mines and works visited, and the many courtesies extended, are here gratefully acknowledged.

The instructing staff consisted of Professor Richards, Mr. Locke and Mr. Sawyer, and nineteen students took advantage of the opportunity.

Course IV. Architecture.

Reference was made last year to the gratifying increase in the number of students returning for graduate work. This year the graduate class is one larger than last. Six of this class, one of whom is a graduate of the Option in Landscape Architecture and another of that in Architectural Engineering, are candidates for the degree of Master of Science.

The choice of studies leading to the advanced degree being made largely by the students themselves, although with the aid and advice of the instructors, it has been of interest to compare for a term of years the selections which have been made, with a view to formulating therefrom a regular graduate course which shall at once be attractive to graduate students and acceptable to the Faculty, and which shall lead to the degree of Master of Science. The department is exceedingly well fitted to care for graduate work, and the evolution of a definite graduate course is not intended to interfere with the present latitude as regards choice of work. It will remain as now a simple matter to make slight variations in individual schedules, according to the option graduated from. The graduate students invariably make much of a course of scientific construction, which is as it should be.

The number of students taking the Option in Architectural Engineering, curiously enough, does not increase, although the demand for its graduates is steady, and exceptionally good positions and salaries have been found for them as soon as they were ready to go forth.

If the time devoted to practical problems based on previously taught theory could be extended through the entire first term of the fourth year, the regular student would gain much and the demand for Option 2 would come only from those to whom the æsthetics of architecture do not appeal.

The department is this year working to its full capacity, and it has been found necessary to make use of the exhibition room for recitation purposes.

The greatest need of the department is a museum of building-models and appliances. The demand is for the best practical training that can be given for immediate usefulness when office life begins, and as an aid to this a well-equipped museum, to which manufacturers would be glad to contribute, would be invaluable.

Courses V. and X. Chemistry and Chemical Engineering.

The most important changes in this department are those made in the instruction in inorganic chemistry and in industrial chemistry. Special effort has been made to enrich the instruction in first-year inorganic chemistry and to increase its effectiveness. The lectures are given by Professor Talbot and nine other members of the instructing staff cooperate with him in the conduct of the recitations and laboratory work. Radical changes have been inaugurated in the laboratory work in industrial chemistry in connection with the appointment of Professor W. H. Walker.

Notwithstanding the expansion of laboratory facilities during the past year, involving adequate provision for the first-year class of five hundred students, there is an imperative need of additional space if the department is to maintain its efficiency. Particularly is this true in connection with the instruction in analytical chemistry: this year all but four desks are occupied, and next year will probably show an increase of thirty students in this branch, for whom provision must be made, with a considerable further increase in 1904. It is impossible that the Walker Building should long accommodate both the Department of Physics and that of Chemistry, and, if the Institute is to remain in its present location, it will be absolutely necessary to provide one or more new buildings for these departments.

With each year the need of additional small laboratories for the use of students in connection with thesis work or advanced research is felt more keenly.

As was pointed out in the report of last year, there is great need of an increase in the instructing force of the department, that each member may be able to devote some time to research and to study, and to summon for this work something more than the remnants of energies practically exhausted by long hours of instruction in the laboratory. This increase, however, will be impossible until provision for

additional space is made, as nearly all space available for a working table or even a writing desk is at present occupied.

A Summer School of Industrial Chemistry was inaugurated last June, attended by fifteen students. The plan of instruction included visits to typical manufacturing plants, representing important chemical industries, the series of visits covering a period of two weeks. The details of the trip were carefully worked out in advance by Professor Thorp, who, with Professor Talbot, accompanied the students, and in connection with the inspection of the plants, conferences were held each evening, at which a brief statement of the principles underlying the processes to be inspected on the following day was given by Dr. Thorp, and reports were made by each member of the school upon a specially assigned portion of the plants inspected during the previous day. Elizabeth, N.J. was made the headquarters of the party for the first week, and Philadelphia for the second week.

The following establishments were visited: — Murphy Varnish Co., Newark, N.J.; Passaic Print Works, Passaic, N.J.; Carl H. Schultz Mineral Water Co., New York; Bowker Fertilizer Co., Elizabeth, N.J.; New Jersey Zinc Co., Newark, N.J.; E. R. Squibb & Sons, Pharmaceutical Chemists, Brooklyn; National Lead Co., New York; Standard Varnish Works, Staten Island; Tide Water Oil Co., Bayonne, N.J.; Vulcanite Portland Cement Co., Vulcanite, N.J. Bellmark Pottery Co., Trenton, N.J.; Willetts Mfg. Co., Pottery Works, Trenton, N.J.; Whitall, Tatum Co., Glass Works, Millville, N.J.; Booth, Garrett & Blair, Laboratory, Philadelphia; U.S. Mint, Philadelphia; Midvale Steel Co., Philadelphia; Harrison Bros. and Co., General Chemicals, Philadelphia; Barrett Mfg. Co., Coal-tar Distillers, Frankford, Pa.; Dungan, Hood & Co., Tanners, Philadelphia; and the Baldwin Locomotive Works, Philadelphia.

It is thus evident that the students had opportunity to study a considerable variety of processes, and there seems to be no doubt that the first summer school of industrial chemis-

try was successful. That this is true is due, in a large measure, to the courtesy and kindness extended to the Institute party by these firms, as well as by those in immediate control of the works.

It is gratifying to note the uniform earnestness of those taking part in the summer school, both with respect to the inspections during the day and the evening conferences — an earnestness which elicited favorable comment from many manufacturers and teachers with whom the party came in contact.

Course VI. Electrical Engineering.

Since the beginning of the academic year the Department of Electrical Engineering has been located in the new Augustus Lowell Laboratory of Electrical Engineering, which was erected during the summer. This laboratory covers an area of about 45,000 square feet, and, in addition to lecture rooms, contains a laboratory for electrical measurements, photometer rooms, a number of research rooms, and a main power and testing floor 300 feet in length by 40 feet in width. At the end of this testing floor, and separated from it by a wall, is a boiler room with space for boilers aggregating 750 horse-power, of which boilers of 500 horse-power have been ordered and are being installed. The main testing floor will contain the power plant, which consists of one 480-kilowatt, double current set; one 150-kilowatt, three-phase set; two 75-kilowatt, direct current, three-wire machines, and two 25-kilowatt machines, driven by a single engine. In addition there are motor-driven units which include a 100-kilowatt, three-phase, 60-cycle dynamo; a 50-kilowatt, 25-cycle, three-phase machine; a 125-kilowatt, 500-volt, direct current machine, and some smaller units. By using Scott transformers the three-phase current can be changed to two-phase. In addition to these machines there is a number of direct and alternating current dynamos and motors from 30 kilowatts down to one kilowatt, and a great deal of other apparatus such as

static transformers, etc. A very complete set of measuring apparatus is owned by the department, the greater part of which is now available for use. The new laboratory, with its unusual equipment, offers facilities for instruction and research which are unsurpassed in this country or abroad.

A number of changes are contemplated in the courses and in the methods of instruction, to take effect next year. It has not been practicable to modify the course of instruction greatly during the present academic year, though a few additional lectures will be given, including a course on electric railroad work. It is hoped that the facilities for laboratory work will be much better than those for last year, although the delivery of the additional apparatus ordered is not so rapid as could be wished.

Course VII. Biology.

The most striking feature of the year in this department has been its productiveness in research and publication. In January Mr. S. C. Prescott, Instructor in Industrial Biology, brought out, through the press of Messrs. John Wiley & Sons, a translation of an important volume on the soluble ferments, entitled "Enzymes and Their Applications," from the French of Professor Jean Effront, a European authority on the subject connected with the Zymotechnical Institute of Brussels. In May Professor Sedgwick's treatise on the "Principles of Sanitary Science and the Public Health," to which reference was made in the last report, was issued from the press of the Macmillan Company, and has met with a favorable reception both in this country and abroad.

Among the more important contributions from this department to the proceedings of learned societies or to scientific or technical periodicals during the past year may be mentioned a memoir describing the results of extensive experiments on the influence of cold upon the bacillus of typhoid fever, with special reference to the problem of ice-supply and the public health; a paper upon the results of ergographic studies on

the muscular soreness frequently observed after muscular work; the discovery of a remarkable similarity between the common intestinal bacillus often used in tracing sewage pollution and certain lactic-acid bacteria; a bacterial study of the self-purification of streams, carried out upon the Sudbury River; the conditions governing the troublesome occurrence of eels in water works, and suggestions for their control; the sanitary importance, in view of the malaria problem, of gold-fish as destroyers of mosquito larvæ; and a report to the Commissioners of Fisheries of the Commonwealth upon the scientific basis of the lobster industry and the causes of the decline of the latter, together with suggestions for radical improvement in the lobster laws of New England.

Classes in physics and chemistry from Boston University have for several years been taught in the Institute laboratories by Institute professors, and, beginning with the present year, the biological classes of that institution will be similarly conducted.

The staff of this department has been enlarged and strengthened by the appointment of George W. Field, Ph.D., as Instructor in Economic Biology. Dr. Field is a graduate of Brown University and of Johns Hopkins University and was, not long before his appointment, Assistant Professor at Brown University and Biologist to the Rhode Island Agricultural Station.

Several young men engaged professionally in fermentation or food-preserving industries, or on the biological side of sanitary engineering, have recently come to the Institute for advanced work in the laboratories of industrial or sanitary biology, and the department seems likely to be called upon henceforward to provide opportunities for the most advanced workers in these subjects, as it is doubtless true that nowhere in this country are better facilities provided for work of this kind than at the Institute. Although the number of regular students in the department has always been small, there is a steady demand, not alone for those who have taken the regu-

lar course, but also for others, especially graduate or special students, who have been able to give one or two years to the advanced work of the department. Its greatest need is larger facilities for experimental work in industrial and in sanitary biology for the benefit of such advanced students. Some relief will probably be found in this direction from the generous gift lately made to the Institute for experiments upon the purification of sewage. The administration of this gift has been placed under the general direction of Professor Sedgwick, who is making plans for its wise and effective use.

Course VIII. Physics.

The expectation of moving from the Walker Building made it inexpedient to attempt large changes in the arrangement or equipment of our laboratories, even when this was possible, and has hindered the development of our work, as has indeed been the case for several years past. There has, nevertheless, been a distinct gain in the facilities of the several branches of the Rogers Laboratory of Physics, and also a very embarrassing increase in the number of students pursuing special work.

The Laboratory of General Physics has been filled to its utmost capacity, and next year it will probably be necessary to keep it open to students continuously from nine o'clock until five. The introduction of a system of weekly conferences on the work of this laboratory, which was instituted last year with students from some of the Courses, has very greatly enhanced the value of the laboratory instruction for these students.

It is worthy of note that all the experimental work in connection with the proposed Insurance Engineering Experiment Station has been carried on in the Rogers Laboratory, and it is hoped that this arrangement may continue until the new station is completed.

For the Option in Electro-Chemistry eighteen students have registered this year, of whom four are graduates of

other colleges, a result which indicates an even greater demand for a course of this character than was anticipated.

The most important change in the Department of Physics has been the separation from it of the work in Electrical Engineering, and the institution of a distinct department for this, a procedure which has been in contemplation for several years, but for which the time has not heretofore seemed ripe. At the date of the institution of the Course in Electrical Engineering, and for a number of years thereafter, this subject was in reality a branch of applied physics, and it was not inappropriate that this Course, which had grown up in the Department of Physics, should remain there; but, with the application of electricity as a source of power, the principal problems to be dealt with came to be so largely of a distinctly engineering character as to make it evident that the best interests of such a course would be secured by placing it upon an independent basis when that should become feasible. It remains true, however, that the work of the Physical and the Electrical Engineering Departments is and always must be closely allied.

The space freed by the removal of the Laboratory of Electrical Engineering will be occupied by the Laboratories of Heat Measurements and Electro-Chemistry, besides affording a small amount of room for thesis work.

Course IX. General Studies.

The most important event in the work of the English Department during the year has been the development and extension of the idea of co-operation with other courses in the third and fourth years. Before this year from the Course in Mining Engineering have been received technical memoirs and from the Course in Architecture architectural studies. These, after having been examined in the several departments to which they belong, come to the English Department for criticism on clearness and effectiveness of expression. The

principle is now extended, in various forms, to the Courses in Mechanical Engineering, Chemistry, Electrical Engineering, Physics, and Sanitary Engineering. This combining of actual technical work with criticism of English has long been urged by the department. In Courses III. and IV. it has proved very helpful, and it seems likely to be no less so in the others where it has now been introduced.

The department is more and more strongly impressed by the great importance of extending freshman English through the second half of the year. By the end of the first term a large proportion of the students have been brought to the point where they have especial need of continued practice. They have gained a sufficient knowledge of the theory of composition, and they have learned to express themselves with clearness and propriety. What they need further — and most seriously need,— is to be held to the practice until their knowledge has ripened into habit. Unless it becomes a habit it is very soon lost altogether. Composition is of no value whatsoever as a mere theory; it must be a practical art or it is nothing. The work of a second term in composition should in value be triple that of the first, and cannot be too strongly insisted upon.

The only notable change in connection with the instruction in history is in dividing the European History class into two sections; and a similar division will be made in first-year United States history. The results of dealing with smaller classes have been good, and there has been a better showing on the part of the students. A new course has been given by Professor Sumner on the History and Art of the Italian Renaissance, for graduate students in architecture.

Course XII. Geology.

During the past year certain changes have been made in the curriculum, with a view to emphasizing the importance of the practical aspects of the science, by devoting more time to

mineralogy, field geology, chemical geology and ore-deposits, and economic and applied geology. Time for these subjects has been obtained by reducing the allowance for dynamical and historical geology. In brief, the idea has been, throughout, to offer to each department such courses in geology as would be most pertinent to its work and needs, and to put the instruction upon the practical basis befitting a technical school. As a general result of the changes here indicated, the more practical work in geology, heretofore restricted to the few students in the Course in Geology, is now given to those in the Courses in Civil Engineering, Mining Engineering, Architecture, and Sanitary Engineering, and to classes aggregating from one hundred to one hundred and fifty students.

Owing to the resignation of Professor Niles and the retirement of Professor Barton from all instruction excepting that given to students of Boston University, there has been a general redistribution of the work of the department, which is now being carried on under the general direction of Professor Crosby, with the co-operation of members of the Geological Department of Harvard University, who have given courses as follows: —

Dr. T. A. Jaggar, Jr., in General Geology, Experimental Geology and Field Geology.

Professor N. S. Shaler, in General Geology.

Professor W. M. Davis and Mr. M. A. Read, in Physiography.

Professor R. De C. Ward and Mr. F. M. Wilder, in Climatology.

Professor J. B. Woodworth, in Glaciology.

This co-operation has been of high value to our students, the only difficulties arising being those resulting from conflicts of tabular views and the loss of students' time consequent upon the journey to Cambridge and return.

There is urgent need of more room for the storage and convenient use of the geological collections, as well as for advanced laboratory and experimental work in geology.

Course XIII. Naval Architecture.

In accordance with the decision of the U.S. Navy Department, mentioned in the report of last year, to send its cadets to the Institute for special instruction in naval architecture, four additional cadets were detailed here for the present year. At the end of last year the course provided for these cadets was carefully revised, with the aid of the corps of Naval Constructors, and may now be considered established in a complete and satisfactory form. By the elimination of certain subjects, in which the cadets proved to have had already sufficient instruction, it was found possible to augment the instruction in war-ship design, which, in the hands of Professor Hovgaard, is being developed along the most modern and scientific lines. In view of the extensive application of electricity in ship construction, a course has been laid out, with adequate training in the physical and electrical engineering laboratories.

The establishment of the course for cadets and the consequent strengthening of the department make it possible to offer a graduate course in naval architecture, open to all students properly qualified, in which provision will be made for the study of war-ship design and cognate problems.

Notwithstanding the expansion of the department during the past year, there is an urgent need for additional drawing-room space, as well as for a room for models and other similar material.

Last summer a special summer course of two weeks was given in mold-loft work. For this purpose the lines of the ship selected were drawn to a large scale and were used as the basis for the construction of a full-sized body plan and scrive board. Some of the most progressive shipyards have used similar methods for many years and have found it advantageous to make the large-scale drawings mentioned, on marble slabs. If we are adequately to develop this important method of instruction we should, in like manner, use marble

slabs or some equivalent; the material will not be unduly expensive, but space is now lacking for its proper accommodation.

Through the interest of Dr. Weld the students this year are to be each given an opportunity to make a model of the ship he is designing, in order that he may gain a proper appreciation of the form which his ship-lines represent. A room in the building on Garrison St. has been fitted up with proper benches and tools, and a competent instructor provided. Sufficient time will be allotted from the drawing hours, and it is expected that the work of finishing such models will so interest the students that they will consider it a relaxation from their regular work.

An extensive set of lithograph plates has been prepared under the direction of Mr. Leland, representing the framing and construction of ships in steel and wood, showing the standard forms of construction and various modifications, especially those that have been developed in the American yards. This will enable us greatly to improve the instruction in this important subject.

Mathematics.

The changes in the Department of Mathematics during the past year have been important.

Dr. John D. Runkle, Professor of Mathematics from the foundation of the Institute, retired from active teaching at the beginning of the year in consequence of impaired health, and after several months of failing strength, died early in July. No account of Dr. Runkle's service to the Institute in general, and to the department of mathematics in particular, need here be given. The library of the department, to which his name was attached some years ago, will preserve his memory for those who had not the good fortune of direct association with him.

Instruction in mathematics has been conducted at the In-

stitute heretofore without formal departmental organization. Since Professor Tyler's appointment as head of the department, he has endeavored to initiate, and to some extent to carry out, the following lines of policy: —

An examination of the mathematical preparation which can be secured from secondary schools;

The determination of the kind and amount of mathematical training required by the professional departments;

The better adaptation of the undergraduate courses to the work of the schools, on the one hand, and to that of the professional departments on the other;

The development of mutually helpful relations among members of the department by frequent conferences, not only in regard to mathematical instruction, but in regard to subjects of general mathematical interest.

The department has been strengthened by the appointment of two additional instructors.

Modern Languages.

The Department of Modern Languages is, this year, owing to its transference to the new Lowell Building, working under the most favorable conditions it has yet experienced. All its members have their classes and sections, with the exception of a single section, in this building, and the consequent saving of time and gain in efficiency is most gratifying. This change has made possible a long-desired reorganization of the departmental library, which will render it easier of access to both students and members of the department.

Three courses are now being given in Spanish, for the benefit of the Naval Cadets of Course XIII., and it may seem desirable that this instruction be augmented, next year, by additional exercises in conversation, preferably under the direction of a native teacher.

Mechanic Arts.

The total numbers of students receiving instruction in the Mechanical Laboratories is 347, many of whom take work in more than one subject.

The total numbers of students since 1897–98 are as follows: —

1897–98	210
1898–99	231
1899–00	238
1900–01	272
1901–02	294
1902–03	347

The number of students attending the various classes in the Summer School in Mechanic Arts was fifty-five.

Owing to the continued increase in numbers the special class in drawing and mechanic arts was discontinued this year. The number of sections taking machine-tool work was increased from two to three, all of which are now full. The number of lathes in the machine-tool laboratory should be increased from 23 to at least 30 if we are to care properly for the increasing numbers of students. The sections in forging have been increased from three to five, and nearly all now contain the maximum number of students. To carry on successfully the work in forging and chipping and filing during the second term an additional assistant will be needed.

A plain milling machine has been added to the equipment of the machine-tool laboratory, and the twist drill grinder has been replaced by a more modern one.

As was pointed out in the report of last year, instruction rooms similar to that of the machine-tool laboratory are very much needed.

Mr. R. H. Smith, Instructor in Machine-tool Work, has now nearly ready for publication a text-book of "Machine Construction" for use in his classes.

PUBLICATIONS OF MEMBERS OF THE INSTRUCTING STAFF.

Astronomy.

PERCIVAL LOWELL.— The Solar System. Six Lectures. Houghton, Mifflin & Co.

Civil Engineering.

G. F. SWAIN.— Annual Report to the Railroad Commissioners on Railroad and Street Railway Bridges. *Report of the Massachusetts Railroad Commission*, pp. 28–31, 53, January, 1902.

G. F. SWAIN.— The Value of Non-resident Lectures on Engineering Subjects. *Proceedings of the Society for the Promotion of Engineering Education*, 1902.

A. E. BURTON (with HARRISON W. SMITH and GEORGE L. HOSMER).— Report of the Massachusetts Institute of Technology Eclipse Expedition to Sumatra in 1901. *Technology Quarterly*, Vol. 15, pp. 9–50.

A. E. BURTON.— An Eclipse Expedition to the Island of Sumatra. *Technology Review*, Vol. 4, pp. 38–56.

DWIGHT PORTER.— Water Power and Coast Streams of New Hampshire. 22nd U.S. Geological Survey Report, Part IV.

G. L. HOSMER.— A Short Method of Finding Time by Equal Altitudes of Two Stars. *Technology Quarterly*, Vol. 15, pp. 81–85.

Mechanical Engineering.

G. LANZA.— Steel Rivets. *Proceedings of the American Association for Testing Materials*, 1903.

E. F. MILLER.— Waste Heat Engines. Proceedings of the New England Waterworks Association, *Engineering Record*, and *Engineering News*.

E. F. MILLER.— Report upon the Equipment of European Engineering Laboratories. *Technology Review*.

J. C. RILEY.— Apparatus for Obtaining a Continuous Record of the Position of an Engine Governor, and the Speed of the Engine which it is Governing. *Proceedings of the American Society of Mechanical Engineers*. Presented at the meeting of December, 1902.

Mining Engineering and Metallurgy.

R. H. RICHARDS.— Progress in Gold Milling during 1901. *The Mineral Industry*, Vol. 10, p. 330.

R. H. RICHARDS.— Review of the Literature on Ore-Dressing in 1901. *The Mineral Industry*, Vol. 10, p. 747.

R. H. RICHARDS.— "Ore-Dressing," in Encyclopedia Britannica Supplement.

H. O. HOFMAN.— Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. 10, p. 417.

H. O. HOFMAN.— Aluminum as a Reducing and Heat-Producing Agent. *Technology Quarterly*, Vol. 15, p. 93.

H. O. HOFMAN.— Review of A. James's "Cyanide Practice," *Technology Quarterly*, Vol. 15, p. 232.

H. O. HOFMAN.— "Lead" in Encyclopedia Britannica Supplement.

H. O. HOFMAN.— "Silver" in Encyclopedia Britannica Supplement.

Chemistry.

H. P. TALBOT.— An Introductory Course of Quantitative Chemical Analysis. Fourth revised edition. Macmillan Co. New York. 1902.

H. P. TALBOT.— The Recorded History of the Argon Group. *Technology Quarterly*, June, 1902.

H. P. TALBOT and J. W. BROWN.— A Bibliography of the Analytical Chemistry of Manganese. Smithsonian Collection, Vol. 41, No. 1313, 1902.

A. A. NOYES.— General Principles of Physical Science. 170 pp. Henry Holt & Co.

A. A. NOYES and G. V. SAMMET.— Lecture Experiments Illustrating Various Types of Catalytic Action. *Journal of the American Chemical Society*, Vol. 124, pp. 498–515. *Zeitschrift für physikalische Chemie*, Vol. 41, pp. 11–27.

A. A. NOYES and G. V. SAMMET.— The Equivalent Conductivity of the Hydrogen Ion Derived from Transference Experiments with Hydrochloric Acid. *Journal of the American Chemical Society*, Vol. 24, pp. 944–968.

A. A. NOYES and D. A. KOHR.— The Solubility Equilibrium between Silver Chloride, Silver Oxide, and Solutions of Potassium Chloride and Hydroxide. *Journal of the American Chemical Society*, Vol. 24, pp. 1141–1148.

W. H. WALKER.— A Process for Annealing Sterling Silver. U.S. Patent No. 712027. *Official Gazette*, Vol. 101, p. 707.

W. H. WALKER (with A. D. LITTLE and H. S. MORK).— The Preparation of the Fatty Acid Esters of Cellulose. U.S. Patent No. 709922. *Official Gazette*, Vol. 100, p. 2810.

W. H. WALKER (with A. D. LITTLE and H. S. MORK).— The Preparation of a Non-explosive Waterproof Artificial Silk. U.S. Patent No. 712200. *Official Gazette*, Vol. 101, p. 767.

A. H. GILL.— Gas and Fuel Analysis for Engineers. Third revised and enlarged edition. 1902.

A. H. GILL and H. R. HEALEY.— Some Thermal Properties of Naphthas and Kerosenes. *Technology Quarterly*, March, 1902.

A. H. GILL and S. B. MILLER.— The Specific Heat of Glycerine Waste Lyes and Crude Glycerine. *Journal of the Society of Chemical Industry*, Vol. 21, p. 833.

A. H. GILL, C. H. DENNISON and A. W. ROWE.— Some Data on the Analys's of Oils. *Journal of the American Chemical Society*, Vol. 24, p. 466.

W. R. WHITNEY and A. G. WOODMAN.— The Microscopic Examination of Paper Fibres. *Technology Quarterly*, September, 1902.

W. R. WHITNEY and J. E. OBER.— Ueber die Ausfällung der Kolloide durch Elektrolyte. *Zeitschrift für physikalische Chemie*, Vol. 39, p. 5.

W. R. WHITNEY.— Colloids. *Transactions of the American Institute of Electrical Engineers*, Vol. 19, No. 6, June and July, 1902.

W. R. WHITNEY and A. C. MELCHER.— An Investigation of Ammonio-silver Compounds in Solution. *Journal of the American Chemical Society*, Vol. 25, pp. 69–83.

HENRY FAY.— Absonderung von Phosphor im Eisen. *Stahl und Eisen*, Vol. 22, p. 955.

JAMES F. NORRIS, B. G. MACINTIRE and W. M. CORSE.— The Decomposition of Diazonium Salts with Phenols. *Technology Quarterly*, December, 1902.

JAMES LOCKE.— Electro-affinity as a Basis for the Systematization of Inorganic Compounds. *American Chemical Journal*, Vol. 27, p. 106.

JAMES LOCKE.— On Some Double Sulphates of Thallic Thallium and Cæsium. *American Chemical Journal*, Vol. 27, p. 280.

JAMES LOCKE.— The Periodic System and the Properties of Inorganic Compounds. IV. The Solubility of Double Sulphates of the Formula $M^{I}_{2}\ M^{II}\ (SO_4)_2\ 6\ H_2O$. *American Chemical Journal*, Vol. 27, p. 457.

JAMES LOCKE.— The Electro-affinity Theory of Abegg and Bödlander. *American Chemical Journal*, Vol. 28, p. 403.

JAMES LOCKE.— The Problem of the Systematization of Inorganic Compounds. *Zeitschrift für anorganische Chemie*, Vol. 32.

ELLEN H. RICHARDS and ISABEL F. HYAMS.— Notes on Oscillaria Prolifica (*Greville*). Second Paper: Chemical Composition. *Technology Quarterly*, September, 1902.

A. G. WOODMAN, C.-E. A. WINSLOW and PAUL HANSEN.— A Study of Self-purification in the Sudbury River. *Technology Quarterly*, June, 1902.

A. G. WOODMAN.— The Significance of Phosphates in Natural Waters. *Journal of the American Chemical Society*, Vol. 24, p. 735.

W. D. COOLIDGE (with F. A. LAWS).— An Apparatus for the Rapid Comparison of Voltameters. *Technology Quarterly*, March, 1902.

WILLIAM T. HALL. Analytical Chemistry, by F. P. Treadwell, Ph.D. Vol. I. Qualitative Analysis (Translation from the second German edition). John Wiley & Sons. New York. 1902.

Physics.

F. A. LAWS and W. D. COOLIDGE.— An Apparatus for the Rapid Comparison of Voltameters. *Technology Quarterly*, March, 1902.

H. M. GOODWIN.— Notes on Physical Laboratory Experiments: General Physical Measurements and Mechanics. Printed by the Institute

LOUIS DERR (Editor).— Cyclopedia of Engineering. American Technical Society. Boston, 1902.

LOUIS DERR.— The Efficiency of Photographic Shutters. *Technology Quarterly*, September, 1902.

C. L. NORTON.— Tests of Sound-proof Partitions. Report No. 1 Insurance Engineering Experiment Station, July, 1902.

C. L. NORTON.— Fireproof Wood "So-Called." Report No. 2 Insurance Engineering Experiment Station, July, 1902. *Insurance Engineering*, Vol. 4, p. 30.

C. L. NORTON.— Further Researches on the Diffusion of Light. Report No. 3 Insurance Engineering Experiment Station, September, 1902.

C. L. NORTON.— Corrosion of Steel Frames of Buildings. Report No. 4 Insurance Engineering Experiment Station, October, 1902. *Technology Quarterly*, November, 1902.

C. L. NORTON.— Portland Cement as a Protection from Fire. *Insurance Engineering*, Vol. 3, p. 118.

C. L. NORTON.— Some Examples of Insurance Engineering from the Factory Mutuals. *Insurance Engineering*, Vol. 3, pp. 211.

C. L. NORTON.— Laboratory Notes on Heat Measurement, November, 1902. Printed by the Institute.

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W. T. SEDGWICK.— Principles of Sanitary Science and the Public Health. 8vo. 1. Vol., 368 pp. & XI.; illustrated. The Macmillan Co. New York. May, 1902.

W. T. SEDGWICK.— On the Modern Subjection of Science and Education to Propaganda. Presidential Address, American Society of Naturalists. *Science*, N. S., Vol. 15, No. 367, pp. 44–54, January 10, 1902.

W. T. SEDGWICK (with C.-E. A. WINSLOW).— I. Experiments on the Effect of Freezing and Other Low Temperatures upon the Viability of the Bacillus of Typhoid Fever, with Considerations Regarding Ice as a Vehicle of Infectious Disease. II. Statistical Studies on the Seasonal Prevalence of Typhoid Fever in Various Countries and its Relation to Seasonal Temperatures. *Memoirs of the American Academy of Arts and Sciences*, Vol. 12, No. 5, August, 1902.

THEODORE HOUGH.— Ergographic Studies on Muscular Soreness. *American Journal of Physiology*, Vol. 7, p. 76, April, 1902.

Reprinted in *The American Physical Education Review*, Vol. 7, p. 1, November, 1902.

R. P. BIGELOW.— Articles on "Evolution," "Fission," "Gastrula," "Growth," "Heredity," "Impregnation," and "Longevity" in *Reference Handbook of the Medical Sciences* (Second Edition), Vol. 4 and Vol. 5. William Wood & Co. New York.

S. C. PRESCOTT.— Enzymes and Their Applications. Translation from the French of Jean Effront. Vol. I. John Wiley & Sons. New York. January, 1902.

S. C. PRESCOTT.— Preservatives and Their Use in Foods. *The Canner and Dried Fruit Packer*, February 27, 1902, p. 23. *The Trade*, Vol. 24, No. 27. *American Grocer*, February 19, 1902. *Technology Quarterly*, Vol. 15, pp. 335–342.

S. C. PRESCOTT.— On the Apparent Identity of the Cultural Reactions of Bacillus Coli and Certain Lactic Acid Bacteria. *Science*, N. S., Vol. 15, No. 375.

S. C. PRESCOTT.— A Note on Methods of Isolating Colon Bacilli. *Science*, N. S., Vol. 16, No. 408.

C.-E. A. WINSLOW.— The Bacteriological Analysis of Water and its Interpretation. *Journal of the New England Water Works Association*, Vol. 15, No. 6, December, 1901

C.-E. A. WINSLOW and Miss M. P. HUNNEWELL.— Streptococci Characteristic of Sewage and Sewage-polluted Waters apparently not hitherto reported in America. *Science*, N. S., Vol. 15, No. 386, May, 1902.

C.-E. A. WINSLOW (with W. T. SEDGWICK).— I. Experiments on the Effect of Freezing and Other Low Temperatures upon the Viability of the Bacillus of Typhoid Fever, with Considerations Regarding Ice as a Vehicle of Infectious Disease. II. Statistical Studies on the Seasonal Prevalence of Typhoid Fever in Various Countries, and its Relation to Seasonal Temperature. *Memoirs of the American Academy of Arts and Sciences*, Vol. 12, No. 5, August, 1902.

C.-E. A. WINSLOW.— A Statistical Study of the Fatality of Typhoid Fever at Different Seasons. *Quarterly Publications of the American Statistical Association*, N. S., Vol. 8, No. 59, September, 1902.

G. W. FIELD.— Eels in Water Works and their Control. *Journal of the New England Water Works Association*, Vol. 15, No. 5, pp. 390–405. Abstract in *Engineering Record*, Vol. 43, No. 13, p. 303.

G. W. FIELD.— A Report upon the Scientific Basis of the

Lobster Industry, the Apparent Causes of its Decline, and Suggestions for Improving the Lobster Laws. *Report of the Massachusetts Commissioners of Fisheries and Game for 1901* Public Documents No. 25, pp. 121–130.

G. W. FIELD.— The Biological Basis of Legislation Governing the Lobster Industry. *Science*, N. S., Vol. 15, No. 381, pp. 612–616.

W. L. UNDERWOOD.— Goldfish as Destroyers of Mosquito Larvæ. *Science*, N. S., Vol. 14, No. 365, pp. 1017–1018, December 27, 1901.

W. L. UNDERWOOD.— The Water-Garden and the Mosquito Problem. *Country Life in America*, Vol. 2, No. 4, pp. 145–147.

W. L. UNDERWOOD.— The Economic and Sanitary Importance of Cleanness in the Canned Goods Industry. *The Canner and Dried Fruit Packer*, Vol. 14, No. 6, pp. 26–29.

Geology.

W. O. CROSBY.— The Origin of Eskers. *Proceedings of the Boston Society of Natural History*, Vol. 30, pp. 375–411. *American Geologist*, Vol. 30, pp. 1–39.

W. O. CROSBY.— Geological History of the Hematite Iron Ores of the Antwerp and Fowler Belt in New York. *Technology Quarterly*, Vol. 14, pp. 162–170. *American Geologist*, Vol. 29, pp. 233–242.

W. O. CROSBY.— Origin and Relations of the Auriferous Venis of Algoma (Western Ontario). *Technology Quarterly*, Vol. 15, pp. 161–180.

W. O. CROSBY.— A Study of Hard-packed Sand and Gravel. *Technology Quarterly*, Vol. 15, pp. 260–264.

Modern Languages.

A. RAMBEAU.— Augier's "L'Aventurière" of 1848 and 1860. *Modern Language Quarterly*, Vol. 5, No. 3, p. 129.

F. VOGEL.—Storm's "Geschichten aus der Tonne." D. C. Heath & Co., 1903.

THE LIBRARIES.

The total number of additions to the Libraries during the year 1901–1902 was 3,872, of which 1,406 were by purchase, 961 from the bindery, and 1,505 were gifts. After deducting books counted twice, etc., the total net increase in the size of the library amounts to 3309 volumes, 403 pamphlets, and 136 maps. The distribution and cost of these is shown in the following table:

TABLE OF THE NET ACCESSIONS FOR THE YEAR 1901-1902, WITH THE COST OF THE SAME, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1902.

	Libraries	Net Increase				Total Contents.	
		Volumes	Pamphlets	Maps	Cost	Volumes	Pamphlets and Maps
General Library.	General	331	153	—	$207.41	5,266	4,086
	English	86	—	—	338.81	2,868	40
	Modern Languages,	49	—	—	95.87	981	24
	Military Science	5	—	—	2.33	325	7
	Totals	471	153	—	$644.42	9,440	4,157
	Architecture	323	15	—	611.41	3,136	228
	Biology	144	28	—	229.42	2,679	494
	Chemistry	328	32	—	612.32	8,696	1,670
	Engineering	779	58	1	1,293.47	10,860	4,053
	Geology	96	4	135	159.07	2,284	1,113
	History and Economics	417	51	—	324.11	11,225	3,387
	Mathematics	114	7	—	211.42	1,232	198
	Mining	296	12	—	472.40	3,235	506
	Physics	333	43	—	602.53	7,315	863
	Margaret Cheney Room	8	—	—	—	625	13
	Totals	3,309	403	136	$5,160.57	60,727	16,682

The number of serial publications received regularly by the Institute during the year 1901–1902 was 881, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1901–1902

Libraries	Number Received						Estimated Cost			
	Gifts	Charged to Departments	Periodical Account: Exch.	Subs.	Totals	Departmental Accounts	Periodical Account: Exch.	Subs.	Totals
General	38	18	16	48	107	$77.33	$32.00	$119.95	$229.28
Architecture	6	8	4	12	40	16.89	6.00	151.92	194.81
Biology	4	19	19	14	70	53.38	18.00	191.66	283.04
Geology	9	2	6	7	24	2.45	12.00	30.71	45.16
Chemistry	17	12	16	29	94*	109.77	32.00	160.68	302.45
Engineering	20	51	64	57	197	131.25	178.00	94.74	403.99
History and Economics	51	54	2	58	165	93.93	4.00	175.68	273.61
Mathematics		8		13	16	7.66		53.48	61.14
Mining	8	7	28	21	64	36.04	56.00	82.66	165.30
Physics	14	18	14	24	89	63.80	68.00	114.39	246.19
Totals	164	212	193	312	881	$602.90	$386.00	$1,305.87	$2,204.77

The expenditures for the Libraries, exclusive of salaries, were as follows:

Books and Binding	$5,160.57
Periodicals	1,753.64
Supplies	244.71
Total	$7,158.92

The General Catalogue contained on September 30th the very considerable number of 55,941 cards, of which 2,831 had been added during the year. There were issued during the year 1199 orders for new books, and 1265 for binding. In

* Not including experiment station reports.

five of the libraries the number of books borrowed during the year was as follows:

General Library	1383
Engineering "	962
Chemical "	1893
Mining "	230
Biological "	157

Among the most noteworthy gifts of the year may be mentioned the sum of $210 for periodicals from Mrs. William B. Rogers; from Mrs. Waldo O. Ross, "the Gardener's Chronicle" besides 290 books and pamphlets on botanical subjects; from Miss Annie Q. T. Parsons, "Knight's Shakespere" for the Margaret Cheney Reading Room; from Professor William H. Niles, 5 volumes on biological subjects. We have received also from Mr. A. J. Sweet, and other Cornell students, "the Cornell Daily Sun." Mrs. Henry Draper has sent another part of "Die Architektur der Renaissance in Toscana." From Yale University we have received 10 volumes of the Bicentennial Publications.

STATISTICS.

The Corps of Instructors.

The Catalogue of this year shows the number of instructors of all grades to be 165, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 183. This year's Catalogue will show a decrease of twenty-two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to nine and seven-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1901–02.	1902–03.
Professors	29	28
Associate Professors	9	12
Assistant Professors	25	25
Instructors	50	54
Assistants	36	46
Lecturers	40	18
Total	189	183

Students and Graduates.

The registration of this year, as shown by the Catalogue, amounts to 1,608. The following table shows the registration of successive years from the foundation of the Institute: —

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1870–71	224
1866–67	137	1871–72	261
1867–68	167	1872–73	348
1868–69	172	1873–74	276
1869–70	206	1874–75	248

Year.	No. of Students.	Year.	No. of Students.
1875–76	255	1889–90	909
1876–77	215	1890–91	937
1877–78	194	1891–92	1,011
1878–79	188	1892–93	1,060
1879–80	203	1893–94	1,157
1880–81	253	1894–95	1,183
1881–82	302	1895–96	1,187
1882–83	368	1896–97	1,198
1883–84	443	1897–98	1,198
1884–85	579	1898–99	1,171
1885–86	609	1899–1900	1,178
1886–87	637	1900–1901	1,277
1887–88	720	1901–1902	1,415
1888–89	827	1902–1903	1,608

Students by Classes.

The aggregate number of students for 1902–03 is divided among the several classes, as follows: —

Fellows	5
Graduate students, candidates for advanced degrees	12
Regular students, Fourth Year	195
" " Third "	230
" " Second "	278
" " First "	433
Special students	455
Total	1,608

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years: —

Class.	Regular.	Special.	Total.
Fellows and Graduates of the M.I.T.	17	—	17
Fourth "	195	95	290
Third Year	230	130	360
Second Year	278	184	462
First Year	433	46	479
Total	1,153	455	1,608

The Courses of Instruction.

The following table presents the number of the regular students in the second, third, and fourth years, by courses: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class .	31	34	28	13	14	38	1	3	1	10	7	1	14	195
3d " "	42	43	28	17	14	37	—	13	4	6	1	—	25	230
2d " "	56	56	27	13	30	43	1	4	4	14	4	—	26	278
Total	129	133	83	43	58	118	2	20	9	30	12	1	65	703

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years: —

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1891	81	104	17	33	23	108	11	5	19	28	9	3	—	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	—	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	1	20	556
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575*
1896	99	117	24	65	66	106	7	11	11	34	8	—	25	573*
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	5	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703

* Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years : —

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . . .	5	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	23	4	10	4	1	–	1	–	1	–	–	–	–	2
3d . . .	14	4	4	–	1	–	3	1	–	–	1	–	–	–
4th . . .	23	4	2	4	–	2	5	–	–	–	1	3	–	2
5th . . .	5	–	1	2	–	1	–	–	–	–	–	1	–	–
	70	12	17	10	2	3	9	1	1	–	2	4	–	4

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years : —

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	474	386	175	2	1,037
Chemistry	503	76	117	56	752
English	437	350	24	28	839
French	195	136	55	0	386
Physics	—	397	323	126	846
German	130	269	212	4	615
Mechanic Arts . . .	—	182	84	86	352

The total registration in the Summer School was 214 students; the registration in the various subjects is shown in the following table: —

Mathematics.	
(*a*) Analytic Geometry	14
(*b*) Integral Calculus	5
Applied Mechanics	15
Mechanical Drawing and Descriptive Geometry	42
Mechanic Arts (Shopwork).	
(*a*) Woodwork	8
(*b*) Forging	11
(*c*) Chipping and Filing	5
(*d*) Machine-Tool Work	23
Modern Languages.	
(*a*) French	13
(*b*) German	14
Chemistry.	
(*a*) Inorganic and Analytical Chemistry	46
(*b*) Air, Water, and Food Analysis	3
Physics.	
(*a*) Mechanics, Light, and Electricity	20
(*b*) Heat	5
(*c*) Physical Laboratory	8
Civil Engineering.	
(*a*) Surveying	8
Mechanical Engineering.	
(*a*) Mechanism	8
(*b*) Mechanical Engineering Drawing	8

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	–	–	–	–	–	1	1
Arkansas	–	–	–	–	–	–	1	1
California	–	2	4	1	3	10	5	15
Colorado	–	1	–	1	3	5	5	10
Connecticut	–	4	10	8	6	28	15	43
Delaware	–	–	1	2	–	3	1	4
Dist. of Columbia,	–	3	3	4	4	14	3	17
Florida	–	1	–	–	1	2	–	2
Georgia	–	1	–	–	2	3	3	6
Illinois	–	14	12	7	10	43	6	49
Indiana	–	4	1	2	4	11	3	14
Iowa	–	1	2	1	–	4	4	8
Kansas	–	–	–	–	–	–	1	1
Kentucky	–	–	1	5	2	8	3	11
Louisiana	–	1	1	–	–	2	–	2
Maine	–	6	–	6	11	25	10	35
Maryland	–	2	6	3	5	16	11	27
Massachusetts	15	104	128	167	282	696	239	935
Michigan	–	1	1	–	3	5	5	10
Minnesota	–	2	1	1	2	6	4	10
Missouri	–	1	1	5	4	11	9	20
Montana	–	1	1	–	–	2	1	3
Nebraska	–	1	2	1	1	5	–	5
New Hampshire	–	5	5	7	9	26	8	34
New Jersey	–	–	2	–	6	8	–	8
New Mexico	–	–	1	–	–	1	–	1
New York	1	8	17	20	19	65	31	96
North Carolina	–	1	–	2	–	3	3	6
North Dakota	–	–	–	–	–	–	1	1
Ohio	–	3	6	8	9	26	17	43
Oregon	–	–	–	1	2	3	1	4
Pennsylvania	–	9	3	4	14	30	14	44
Porto Rico	–	–	–	–	1	1	1	2
Rhode Island	–	9	4	5	10	28	12	40
South Carolina	–	–	–	–	2	3	1	4
South Dakota	–	–	–	–	–	–	1	1
Tennessee	–	1	1	–	–	2	1	3
Texas	–	1	2	3	1	7	2	9
Utah	–	–	1	1	–	2	–	2
Vermont	–	–	3	2	4	9	3	12
Virginia	–	1	–	–	1	2	5	7
Washington	–	–	2	–	–	2	1	3
Wisconsin	–	1	1	3	3	10	1	11
Wyoming	–	1	–	–	–	1	–	1
Foreign Countries.								
Australia	–	–	–	–	2	2	–	2
Bermuda	–	–	–	–	–	–	1	1
Brazil	–	1	–	–	2	3	2	5
Chili	–	–	–	–	–	–	1	1
China	–	–	–	1	–	1	–	1
Cuba	–	–	–	–	–	–	1	1
Denmark	–	–	–	1	–	1	–	1
England	–	–	–	1	–	1	2	3
Germany	–	–	1	–	–	1	–	1
Ireland	–	–	–	–	–	–	1	1
Japan	–	–	–	–	–	–	1	1
Manitoba	–	–	–	–	–	–	1	1
Mexico	–	–	1	1	2	4	6	10
New Brunswick	–	1	–	–	–	1	1	2
Nova Scotia	–	2	2	1	1	6	2	8
Ontario	–	–	–	1	–	1	1	2
Scotland	–	–	–	–	–	–	1	1
Turkey	–	1	–	1	1	3	1	4
Total	17	195	230	278	433	1,153	455	1,608

Forty-one states of the Union and one territory, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,608, 935 are from Massachusetts, or 58 per cent. of the whole; 164 are from other New England states; 509 are from outside New England. Of these, 47 are from foreign countries.

A table showing the number of students in each year, from 1896, coming from each state or territory, and from each foreign country, may be not without interest and instruction: —

States.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Alabama	1	1	1	–	1	–	1
Arkansas	1	1	–	–	1	1	1
California	9	9	11	9	10	9	15
Colorado	7	8	8	7	8	6	10
Connecticut	24	30	26	29	35	42	43
Delaware	2	–	–	–	–	–	2
Dist. of Columbia	5	6	3	4	4	3	4
Florida	–	1	–	1	1	1	2
Georgia	3	4	4	3	3	4	6
Hawaiian Islands	–	–	1	–	1	–	–
Idaho	1	1	–	–	–	1	–
Illinois	45	40	51	36	39	44	49
Indiana	3	7	3	5	7	11	14
Iowa	14	12	7	6	10	8	8
Kansas	3	3	–	–	–	1	1
Kentucky	12	10	10	4	5	9	11
Louisiana	–	1	1	1	2	1	2
Maine	27	24	19	25	22	30	35
Maryland	9	8	8	8	13	16	27
Massachusetts	730	739	719	731	770	837	935
Michigan	6	5	9	10	8	12	10
Minnesota	7	8	11	10	7	10	10
Missouri	11	6	10	11	13	19	20
Montana	3	5	2	3	5	4	3
Nebraska	2	2	1	3	4	3	5
Nevada	–	–	–	1	1	–	–
New Hampshire	26	25	25	29	26	31	34
New Jersey	13	15	13	12	8	6	8
New Mexico	–	–	–	–	–	–	1
New York	69	62	68	61	68	79	96
North Carolina	1	1	2	2	2	6	6
North Dakota	–	–	–	–	–	–	1
Ohio	28	30	23	27	27	27	43
Oregon	4	3	3	2	1	2	4
Pennsylvania	42	41	34	33	37	36	44
Porto Rico	–	–	–	–	–	1	2
Rhode Island	20	19	23	32	35	38	40
South Carolina	6	4	1	1	1	2	4
South Dakota	–	–	–	1	1	2	1
Tennessee	1	3	3	4	6	4	3
Texas	2	2	1	2	4	7	9
Utah	2	3	5	6	7	7	2
Vermont	7	11	12	12	15	15	12
Virginia	3	4	3	2	3	5	7
Washington	5	4	7	4	2	4	3
West Virginia	2	1	–	1	1	1	–
Wisconsin	6	6	8	7	8	11	11
Wyoming	1	–	–	–	–	–	1
Foreign Countries.							
Australia	–	–	–	–	–	–	2
Austria	–	–	–	–	–	1	–
Bermuda	–	–	–	–	1	2	7
Brazil	–	–	–	–	–	4	5
Cape Breton	–	–	1	–	–	–	–
Chili	1	–	–	–	–	1	1
China	–	–	–	–	–	1	1
Cuba	2	1	1	–	–	1	2
Denmark	–	2	1	1	1	1	1
Dutch Guiana	–	–	1	1	–	–	–
England	2	2	4	1	3	3	3
France	1	1	1	2	4	1	–
Germany	–	–	1	1	2	3	1
Ireland	–	–	–	–	–	–	1
Jamaica	–	–	–	1	1	1	–
Japan	2	–	1	2	2	2	1
Manitoba	–	–	–	–	–	–	1
Mexico	3	6	7	7	7	7	10
New Brunswick	2	2	3	3	2	2	2
Nova Scotia	1	1	2	–	2	6	8
Ontario	2	–	–	–	–	3	2
Quebec	2	2	1	3	4	2	–
Russia	–	–	–	1	1	1	–
Scotland	–	–	–	–	–	–	1
Turkey	1	3	3	3	3	1	4
Total	1,198	1,198	1,171	1,178	1,257	1,415	1,608

Residence of Massachusetts Students.

It has been said that 58 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and forty-six cities and towns are on the lists. The first column

of the following table shows the number of cities and towns in each county sending pupils: the second column gives the aggregate number from each county. It appears that Suffolk sends two hundred and seventy-eight, and Middlesex two hundred and seventy-three pupils; Essex comes third, with one hundred and thirty-five; Norfolk, fourth, with ninety-seven.

County	No. of Towns.	No. of Students.	County	No. of Towns.	No. of Students.
Barnstable	5	9	Middlesex	32	273
Berkshire	4	9	Nantucket	1	1
Bristol	11	33	Norfolk	21	97
Essex	24	135	Plymouth	19	42
Franklin	3	5	Suffolk	4	278
Hampden	5	16	Worcester	15	32
Hampshire	3	5			
			Total	146	935

The following is a list of the towns, forty-three in number, which send five or more students to the Institute: —

Boston	261	Haverhill	12	Beverly	7
Newton	49	Melrose	12	Springfield	7
Cambridge	33	Brockton	11	Wenham	7
Somerville	22	Taunton	11	Concord	6
Newburyport	21	Fitchburg	10	Marlboro	6
Brookline	20	Quincy	10	Natick	6
Salem	19	Canton	9	Reading	6
Lawrence	18	Chelsea	9	Stoneham	6
Lowell	18	New Bedford	9	Woburn	6
Lynn	16	Winchester	9	Andover	5
Framingham	14	Gloucester	8	Holyoke	5
Malden	14	Weymouth	8	Middleboro	5
Hyde Park	13	Arlington	7	Peabody	5
Medford	13	Belmont	7	Plymouth	5
Waltham	13				

The following table exhibits for ten years the distribution of the total number of students among two classes: first, those students whose names are found upon the Catalogue of the year preceding; and, secondly, those whose names

appear first upon the Catalogue of the year to which the statement relates.

Year.	(1) Total No of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226

Ages of Students.

The next table exhibits the ages of our students upon entrance, after taking out one who is repeating the first year, and fifteen persons of unusual ages. These deductions leave four hundred and seventeen as the number of students whose ages have been made the subject of computation.

Period of Life.	1901–1902.		1902–1903.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	—	—	3	—
16½ to 17 "	4	4	12	15
17 to 17½ "	28	—	30	—
17½ to 18 "	48	76	49	79
18 to 18½ "	47	—	85	—
18½ to 19 "	66	113	65	150
19 to 19½ "	73	—	65	—
19½ to 20 "	41	114	47	112
20 to 20½ "	31	—	28	—
20½ to 21 "	24	55	10	38
21 to 22 "	15	15	23	23
	377	377	417	417

The results appear in the table above in comparison with the corresponding results of 1901–1902.

From the foregoing it appears that the average age on entrance is eighteen years and ten months.

In this connection are presented the ages, at graduation, of the class which left us in June. The one hundred and ninety-three members of the class were distributed among the different periods of life as follows: —

Under 20½	2
Between 20½ and 21	8
" 21 " 21½	16
" 21½ " 22	32
" 22 " 23	54
" 23 " 24	42
" 24 and over	39
Total	193

The special students this year constitute twenty-eight per cent. of the whole body, as against twenty-nine per cent. last year and twenty-seven per cent. the year before.

Graduate Students.

The number of students who are graduates of this and other institutions is one hundred and sixty-one. Of these twelve are candidates for advanced degrees, ten being our own graduates.

One hundred and fifty-one are graduates of the following institutions, and are pursuing courses of study with us either as regular or as special students.

Universities.

Acadia	1	Leland Stanford, Jr.	2
Baylor	1	Maine	1
Boston	2	Miami	1
Brown	4	Northwestern	3
Catholic University of America	1	Pennsylvania	2
Chicago	4	Princeton	3
Colgate	1	Rochester	1
Cornell	3	Tulane	1
Hamline	1	University of the South	1
Harvard	12	Vermont	2
Illinois	2	Virginia	2
Johns Hopkins	4	Washington	1
Kansas State	1	Yale	12
Lake Forest	1		70

Colleges.

Acadia	1	Pennsylvania Military	1
Adelbert	1	Pomona	1
Amherst	4	Radcliffe	1
Bates	1	Randolph-Macon	1
Beloit	1	Rhode Island Agricultural	1
Boston	1	Robert	1
Butler	1	Rock Hill	1
Canisius	1	St. Francis Xavier	1
Central	1	St. Ignatius	1
Christian Brothers	1	St. Joseph	1
City of New York	4	St. Xavier	1
Colby	2	Smith	1
Colorado	1	Southwest Baptist	1
Connecticut Agricultural	1	Southwestern Presbyterian	2
Davidson	2	Syrian Protestant	1
Delaware	1	Texas Agricultural	2
Detroit	1	Throop Polytechnic Institute	1
Earlham	1	Trinity	3
Gallaudet	1	Tufts	2
Georgetown	1	U.S. Naval Academy	6
Grove City	1	Vassar	1
Haverford	1	Villanova	1
Iowa	1	Virginia Medical	1
Kalamazoo	1	Virginia Military	1
Kenyon	1	Wellesley	3
Mass. College of Pharmacy	1	Westminster	1
Mass. Inst. of Technology	10	Williams	1
Milton	1	Winchester Normal	1
Mt. Allison	1	Wittenberg	1
Mt. St. Joseph	1		
Munich Technical Institute	1		94
North Dakota Agricultural	1	Total	164
Neuchâtel Académie	1	Deduct names counted twice	3
Oberlin	1		161

Women Students.

The number of women pursuing courses with us is sixty-three. Of these four are graduates of colleges. Of the total number seven are regular students of the fourth year, five of the third year, five of the first year. Forty-six are special students. Of the twelve regular students of the upper classes, five take Course IV., Architecture; three, Course V., Chemistry; one, Course VII., Biology; two, Course VIII., Physics; and one, Course IX., General Studies. Of the special students, thirty devote themselves to biology, three to chemistry, three to physics, two to architecture, one to general studies, one to naval architecture, and one to mechanical engineering, while five are first-year specials.

Statistics of Admission.

Of the 1,608 students of the present year, 659 were not connected with the school in 1901–1902. Of these 408 were admitted as regular students of the first year upon the basis of their entrance examinations. The 251 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade or from the College Examination Board. In addition to the 408 who were thus admitted to the first year on examination, and have taken their place in the school, 70 were admitted on examination, but have not entered the school.

In the case of the 408 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows: —

Admitted clear	316
" on one condition	75
" on two conditions	17
	408

One hundred and four applicants were rejected.

Entrance Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Austin (Tex.), Belmont (Cal.), Chicago, Denver, Detroit, Kansas City (Mo.), New York, North Adams, Philadelphia, Pittsburg, Portland (Me.), St. Louis, St. Paul, Springfield (Mass.), Syracuse, and Washington.

Graduates by Courses.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:-

Year	Civil Engineering	Mechanical Engineering	Mining Engineering	Architecture	Chemistry	Metallurgy	Electrical Engineering	Natural History or Biology	Physics	General Course	Chemical Engineering	Sanitary Engineering	Geology	Naval Architecture	Total
1868	6	1	6	–	–	–	.	.	.	1	.	–	–	.	14
1869	2	2	–	–	1	–	.	.	.	.	.	–	–	.	5
1870	4	2	2	–	1	–	.	.	–	1	.	.	–	.	10
1871	8	2	5	–	2	–	.	.	.	.	.	–	–	.	17
1872	3	1	5	–	3	–	.	.	.	.	.	–	–	.	12
1873	12	2	3	1	7	–	.	.	.	1	.	–	–	.	26
1874	10	4	1	1	.	–	.	.	.	2	.	–	–	.	18
1875	10	7	6	1	1	–	–	.	1	2	.	–	–	.	28
1876	12	8	7	–	5	1	–	2	3	4	.	–	–	.	42
1877	12	6	8	4	2	–	–	.	.	.	.	–	–	.	32
1878	8	2	2	3	3	–	–	.	.	1	.	–	–	.	19
1879	6	8	3	1	3	–	–	1	1	.	.	–	–	.	23
1880	3	.	3	–	1	–	–	.	–	1	.	–	–	.	8
1881	3	5	6	3	8	–	–	1	–	2	.	–	–	.	28
1882	2	5	5	3	6	–	–	1	1	1	.	–	–	.	24
1883	3	7	5	1	3	–	–	.	.	.	.	–	–	.	19
1884	5	6	13	–	12	–	.	.	.	.	.	.	.	.	36
1885	4	7	8	2	4	–	2	.	.	1	.	–	–	.	28
1886	9	23	7	1	7	–	10	1	.	1	.	–	–	.	59
1887	10	17	8	1	9	–	8	1	1	3	.	–	–	.	58
1888	11	25	4	5	10	–	17	3	1	1	.	–	–	.	77
1889	14	24	5	3	8	–	17	1	1	2	.	–	–	.	75
1890	25	28	3	5	13	–	18	3	2	6	.	–	–	.	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	.	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	.	33	–	2	4	11	4	–	5	144*
1896	25	34	10	24	17	–	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	21	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	17	21	17	–	25	1	1	6	14	4	1	16	199
1902	24	46	15	18	14	.	35	5	3	3	9	7	–	14	193
Totals	498	606	221	236	293	1	467	45	39	88	114	40	9	73	2,725*
Deduct names counted twice															15
Net total															2,710

* Deducting names counted twice.

THE SOCIETY OF ARTS.

Report of the Secretary.

To the President of the Institute:

Sir: — On behalf of the Executive Committee I have the honor to present the annual report of the Society of Arts for the year May 16, 1901, to May 8, 1902.

The first meeting of the Society for the present year was held on October 10, 1901. Fourteen meetings have been held with an average attendance of 216. During the last three years there has been a steady gain in the attendance, which has reached this year three times that of any corresponding period since 1875. Another feature, most gratifying to the Executive Committee, is the increased interest manifested by the students of the Institute in these meetings.

The following papers have been read: —

"The Olympia: A general Description of this famous Ship, and a Discussion of the Development of Cruisers during the Past and the Tendency to Future Progress." NAVAL CONSTRUCTOR WILLIAM J. BAXTER, U.S.N.

"Present Condition of American Railroads as Compared with the Period of Depression 1893–1897." PROFESSOR WILLIAM Z. RIPLEY, Expert Agent on Transportation, U.S. Industrial Commission.

"The Importance of Catalytic Agents in Chemical Processes." PROFESSOR ARTHUR A. NOYES.

"The Development of the Nernst Lamp in America." MR. ALEXANDER J. WURTS, Manager, Nernst Lamp Company.

"The Development of Locomotive Boilers with Particular Reference to the Vanderbilt Boilers." MR. CORNELIUS VANDERBILT.

"The New Star in Perseus." PROFESSOR GEORGE E. HALE, Director, Yerkes Observatory.

"The Utilization of Electricity in Mines." MR. CALVIN W. RICE, Electrician, New York Edison Company.

"Some Features of the Isthmian Canal Question." PROFESSOR W. H. BURR, Member of the U.S. Commission on the Isthmian Canal.

"Engineering in China." MR. WILLIAM BARCLAY PARSONS, Chief Engineer, New York Subway.

"Aluminum as a Reducing and a Heat-Producing Agent." PROFESSOR HEINRICH O. HOFMAN.

"India Rubber: A Description of the Crude Gum and its Manufacture." MR. WALTER E. PIPER, Assistant Superintendent, Boston Rubber Shoe Company.

"Smoke and its Abatement in Large Cities." PROFESSOR C. H. BENJAMIN, Supervising Engineer, City of Cleveland, Ohio.

"A Trip through Siberia." HON. E. J. HILL, Member of U.S. House of Representatives.

"Success in Long Distance Power Transmissions." DR. F. A. C. PERRINE, President of the Stanley Electric Manufacturing Company.

At the beginning of the year, the Associate Membership was three hundred and fifty-four. Of these members one has died, five have resigned, one has been cancelled, and twenty-two have been elected, making the present membership three hundred and sixty-nine. There are thirty-eight Associate Life Members.

The publication of the Technology Quarterly has been continued, as before, under the auspices of the Society of Arts. There has been a regrettable difficulty in obtaining manuscripts of papers read before the Society. Nevertheless, the Quarterly has not lacked material, and has published contributions from a considerable number of the Departments of the School. One of the most notable of these contributions is "The Report of the Massachusetts Institute of Technology Eclipse Expedition to Sumatra in 1901" by Professor Burton and Messrs. H. M. Smith, G. L. Hosmer, and G. H. Matthes Another important contribution from the Civil Engineering Department is "Tests of the Massachusetts Institute of Technology Tape Apparatus," by Professors Burton and Mr. John F. Hayford of the U.S. Coast and Geodetic Survey. The Mechanical Engineering Department contributed the usual quota of "Results of Tests," during the summer, and also a paper by Mr. J. C. Riley on the "Pulsometer Steam Pump." From the Physical Department there was a paper by Professor Laws on "An Apparatus for Recording Alternating Current Waves," and one by him and Dr. Coolidge on "An Apparatus for the Rapid Comparison of Voltmeters." The Chemical Department has furnished three: — "Contributions from the Laboratory of Sanitary Chemistry" by Mrs.

Richards, Mr. Woodman, and Miss Hyams; a paper by Professor Gill and Mr. Healey on "Some Thermal Properties of Naphthas and Kerosenes"; and the "Review of American Chemical Research," edited by Professor Noyes, to December. It was found impracticable for the Chemical Department to continue the preparation of the Review and its publication was discontinued with the issue of the December number of the Quarterly. Mr. Winslow has contributed from the Biological Department a report on "Typhoid Fever at Newport, R.I., in 1900 and its relation to Defective Sanitation," and we have had from Mr. Prescott a paper "On the Application of Bacteriology to certain Arts and Industries." The contributions from the Geological Department are two papers by Professor Crosby, one on "Tripolite Deposits of FitzGerald Lake" and the other on the "Geological History of the Hematite Iron Ores of the Anthwerp and Fowler Belt in New York;" and Mr. F. G. Clapp's thesis on the "Geological History of the Charles River." Messrs. Whipple and Jackson have continued their important series of papers on methods of water examination, and Mr. William Lincoln Smith has furnished a second part of his valuable "Study of Certain Shades and Globes for Electric Lights as used in Interior Illumination."

At the last meeting of the year, the fortieth annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Charles T. Main, and James P. Munroe were re-elected members of the Executive Committee, and Mr. George V. Wendell was re-elected Secretary for the year 1902–1903.

At the October meeting, 1902, the resignation of Mr. Wendell was received and Mr. James F. Norris was elected Secretary.

Respectfully submitted,

JAMES F. NORRIS,
Secretary.

JANUARY 26, 1903.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1902

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1902.

This year there has again been a large increase in the amount received from students' fees, the total being more than $31,000 greater than a year ago; but with the increase in the number of students has come a corresponding growth in the expenses, so that the excess of current expenses over receipts is $5,892.14. A year ago such excess was $9,590.26. In other words, the total increase in receipts for current expenses has been somewhat over $35,000, and the increase in expenses between $31,000 and $32,000 over those of a year ago, making the annual deficit nearly $4,000 less.

A triangular piece of land containing about forty-six hundred square feet and adjoining that previously owned on Stanhope Street, has been purchased in order to bring the front of our land to the future line of Clarendon Street extended.

The new Augustus Lowell Laboratory of Electrical Engineering, covering nearly an acre of ground, was begun July 1. All the work included in the original contract was completed September 17, so that the laboratory was ready for use at the beginning of the new term. The portion of the cost of this new building paid during the financial year was $69,705.12. The very large increase in the number of students has made this building an absolute necessity.

A valuable tract of land in Brookline, near Jamaica Pond, and comprising between eleven and twelve acres, has been bought, the total cost being about $113,000. This purchase makes possible certain much needed extensions of the Institute's work as soon as the necessary funds can be secured.

The following legacies and gifts have been received: —

From Samuel Cabot, Esq., $20,000 to be applied toward the purchase of the above Brookline land.

From A. Lawrence Lowell, Esq., and Percival Lowell, Esq., from each $10,000 toward the erection of the Augustus Lowell Laboratory of Electrical Engineering, and from Mrs. W. Scott Fitz $2,000 for the same object.

From the Robert C. Billings estate an additional sum of $7,500, being the amount of the United States inheritance tax returned by the government.

From G. W. Armstrong, Esq., in memory of his son George Robert Armstrong, $5,000, to be known as the George Robert Armstrong Fund.

From an unnamed donor, through President Pritchett, $5,000 to be used "in experiments with a view of finding out the cheapest and most efficacious way of purifying sewage before it is poured into the rivers and harbors of our country." The giver of this promises an equal amount yearly for two more years, for similar purposes.

From Arthur T. Lyman, Esq., $5,000 for general purposes.

From a friend, through Francis H. Williams, M.D., $1,000 for experiments in the use of the Roentgen-rays.

From the estate of the late Henry L. Pierce, an additional sum of $3,000.

From the estate of the late Susan E. Dorr, an additional sum of $1,956.63.

From the estate of the late Matilda Goddard, $500.

From the Saturday Club, for the purchase of books, $500.

From a friend, for salary account, $500.

From Mrs. William B. Rogers, for the purchase of periodicals, $200.

From Samuel Cabot, Esq., for prizes for designs for medal to be given for improvement in physical development, $25.

The gifts and bequests during the past year to be added to the funds for special purposes amount to $46,951.05, and to the funds for general purposes to $21,000 (page 4). These figures do not include the money given for sewage experiments and for Roentgen-ray investigation, nor $1,225 given to be used during the past year.

The total increase in the funds of the Institute for this year has been $96,524.18, including $26,558.97 cash belonging to the Walker Memorial Fund.

The investments of the Walker Memorial Fund have not been included in the general account of the Institute, but the total amount actually paid into that fund up to the close of the financial year was $68,960, which, together with accumulated interest thereon, makes a total of $71,347.30.

Securities Sold or Paid, General Account.

$2,000	Bur. & Mo. River (Neb.) R.R. 6s	1918	2,000.00
19,000	Walter Baker Co. Lt'd. 4½s	1903	19,000.00
3,000	Ozark Equipment Co. 5s	1910	3,000.00
10	Shares Lowell Bleachery		260.00
55	" Old Boston National Bank		6,160.00
15	" Merchants " "		2,926.50
25	" New England " "		4,000.00
25	" Atlantic " "		3,325.00
37	" Nat. Mechanics Bank, Baltimore		1,147.00
			$41,818.50

Securities Bought, General Account.

$50,000	N. Pac. Great Northern R.R. Joint 4s	1921	$48,500.00

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance, Sept. 30, 1901		28,638.07
From A. Lawrence Lowell for Lowell Institute Courses		5,757.15
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " scholarships (students' fees),	10,175.00	
" " " " Joy "	200.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers	600.00	
" " " " Library	480.00	
" " " " general purposes	27,976.52	
" " Rogers Memorial Fund	10,838.00	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,500.00	
" " " " " Awards	5,385.00	
" " Teachers' Fund	3,800.00	
Letter Box Fund	50.00	
Students' fees	252,987.75	
State Scholarships	4,000.00	
United States Act of 1862	5,501.68	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	11,794.01	
Rents, per Table (page 12)	5,982.80	
Gifts	1,225.00	
Interest	8,920.91	
Boston University	1,150.00	
Sale Printed Lecture Notes	3,218.10	403,137.26
GIFTS AND BEQUESTS OR SPECIAL PURPOSES.		
Increase Scholarship Funds	1,279 42	
" Teachers' Fund	200.00	
" Edward Austin Fund	1,515.00	
" Susan E. Dorr Fund, additional	1,956.63	
Aug. Lowell Lab. Electrical Eng. Fund, add'l,	22,000.00	
Samuel Cabot, toward Brookline land purchase	20,000.00	46,951.05
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	3,000.00	
Matilda Goddard Legacy	500.00	
R. C. Billings Legacy, tax refunded	7,500.00	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	21,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		41,818.50
SUNDRIES.		
Income credited to Bond Premium Acc't	4,622.25	
" " " Rogers Bond Premium Acc't,	825.00	
Boston Art Students' Association, on acc't	666.67	
Notes receivable paid	100,000.00	
Students' Deposits	250.00	
Walker Memorial Fund	40,747.30	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	153,111.22
		$700,413.25

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1902.

Cr.

Paid for Lowell Institute Courses		5,757.15
EXPENSES.		
Salaries, per Table (page 12)	291,501.29	
" paid from Gifts	500.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Edward Austin Fund, Awards	5,385.00	
Teachers' Fund, "	3,800.00	
Prizes, Rotch Funds	400.00	
Prizes, Athletic Medal Designs	25.00	
Repairs, per Table (13)	13,648.76	
General Expenses, per Table (page 13)	17,661.78	
Fire Insurance	2,063 21	
Fuel	10,428.98	
Water	2,866.35	
Gas	2,452.10	
Electricity	1,901.36	
Printing and Advertising	5,909.34	
" Lecture Notes	2,891.19	
" Annual Catalogues and Reports	3,676.65	
Rents paid Boston & Albany R.R. Co.	90.00	
" " Natural History Society	200.00	
" " 71 Newbury Street	1,493.63	
Laboratory Supplies and Libraries, per Table (p. 12)	39,903.27	
Society of Arts	1,408.94	
Pan-American Exposition	22.55	409,029.40
(Expenses more than Income, $5,892.14)		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 3)		48,500.00
Walker Memorial Fund		13,000.00
SUNDRIES.		
Extension Lot, No. 3 Trinity Place	23,210.00	
Aug. Lowell Lab. Electrical Eng. Bldg., 1902	69,705.12	
Brookline Real Estate	112,904.32	205,819.44
Cash balance, Sept. 30, 1902		18,307.26
		$700,413.25

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1902:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

30,000.00	Burlington & Mo. River R.R. 4s.	1910	25,787.50	
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00	
6,000.00	New York & New England R.R. 6s.	1905	6,000.00	
3,800.00	Republican Valley R.R. 6s.	1919	3,800.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00	
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s.	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s.	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s.	1941	34,825.00	
4,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s.	1939	7,000.00	
38,000.00	Chi. Junc. & Union Stock Yards 5s.	1915	38,000.00	
3,000.00	Chi., Mil. & St. Paul R.R. 7s.	1905	3,000.00	
	Advances to Bond Premium acc't		9,207.50	
				250,590.00

INVESTMENTS, GENERAL ACCOUNT.

8,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	8,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00	
5,000.00	Chicago, Burlington & Quincy R.R 4s.	1922	4,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s.	1911	3,000.00	
6,000.00	West End Street Ry. 5s.	1902	6,000.00	
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00	
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00	
26,000.00	Am. Dock & Improvement Co. 5s.	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00	
26,000.00	New York & New England R.R. 6s.	1905	26,000.00	
8,000.00	Chi. Junc. & Union S. Yards 5s.	1915	8,000.00	
5,000.00	Dominion Coal Co. 1st. 6s.	1913	5,000.00	
2,000.00	New England Tel. & Tel. Co. 6s.	1907	2,000.00	
2,000.00	New York & New England R.R. 7s.	1905	2,000.00	
100,000.00	West End Street Ry. 4s.	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s.	1908	50,000.00	
47,000.00	Walter Baker Co., Ltd., 4½s.	1903	47,000.00	
50,000.00	Chi. Terminal & Transfer Co. 1st 4s.	1947	47,507.50	
120,000.00	Illinois Steel Co., non-conv. 5s.	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s.	1939	45,000.00	
100,000.00	Long Island R.R. 4s.	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s.	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s.	1934	8,287.50	
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s.	1907	13,000.00	
50,000.00	Kansas City Stock Yards 5s.	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s.	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s.	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s.	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s.	1947	50,000.00	
100,000.00	Chic. & W. Michigan R.R. 5s.	1921	100,000.00	
100,000.00	American Tel. & Tel. Co. 4s.	1929	99,875.00	
50,000.00	New England Tel. & Tel. Co. 4s.	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s.	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R. 6s.	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s.	1951	24,875.00	
22,000.00	Ozark Equipment Co. 5s.	1910	22,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s.	1921	48,500.00	
	Advances to Bond Premium acc't		40,210.00	
				1,434,797.96
	Amount carried up			$1,685,387.96

Amount brought up $1,685,387.96

STOCKS

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	2,930.00	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	140,627.64

Investment of the Joy Scholarship Fund.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	9,123.70

Investment Swett Scholarship Fund.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,845,139.30

Amount brought up		$1,845,139.30

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering B'ld'g, A, Trinity Place,	90,000.00	166,315.69	
Gymnasium Building		7,967.85	
Engineering Building, B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,260.00	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
Real Estate, Brookline, Mass.		112,904.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		69,705.12	1,605,222.79
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	37,183.80

SUNDRIES.

Notes Receivable	37,000.00	
Boston Art Students' Association	8,999.99	
Students' Notes	770.50	
Cash Balance, Sept. 30, 1902	18,307.26	65,077.75
		$3,552,623.64

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute: —

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,764.40	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	686,850.21
Amount carried up		$686,850.21

Amount brought up		$686,850.21
The income of the following is used towards paying salaries: —		
Nathaniel Thayer, for Professorship of Physics	25,000 00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason, " " Geology	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,267.74	
James Savage "	14,137.87	
Susan H. Swett "	10,182.95	
William Barton Rogers Fund	10,717.89	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,356.27	
Charles Lewis Flint "	5,274.65	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,828.30	
William F. Huntington "	5,225.32	
T. Sterry Hunt "	3,229.33	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,778.15	
Ann White Dickinson "	40,642.92	
Dalton Grad. Chemical "	6,471.44	
Willard B. Perkins "	7,112.75	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	314,349.28
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund		37,378.78
Susan Upham Fund		1,309.54
Susan E. Dorr "		12,956.63
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000 00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		366,549.09
Teachers' "		104,000.00
Saltonstall "		40,600.00
Letter Box "		10.50
MISCELLANEOUS.		
Students' Deposits	450.00	
Henry L. Pierce Legacy, 1898	803,000.00	
Robert C. Billings Legacy, 1900	100,000.00	
Rebecca A. Goddard " 1901	1,000.00	
Barthold Schlesinger " 1901	2,000.00	
Matilda Goddard " 1901	500.00	
Aug. Lowell Lab. Electrical Eng. Fund	32,000.00	
Walker Memorial Fund	26,558.97	
Samuel Cabot. Gift Brookline Land Account	20,000.00	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	
M. I. T. Stock Account	841,620.64	1,833,129.61
		$3,552,623 64

Comparative Statement of Funds, etc.

	Sept. 30, 1901.	Sept. 30, 1902.
Trusts for general purposes	676,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	313,482.26	314,349.28
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,297.64	1,299.54
Susan E. Dorr "	11,000.00	12,956.63
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Henry L. Pierce Legacy	800,000.00	803,000.00
Robert C. Billings "	92,500.00	100,000.00
Saltonstall Fund	40,200.00	40,600.00
Aug. Lowell Lab. Electrical Eng. Fund	10,000.00	32,000.00
Rebecca A. Goddard Legacy	1,000.00	1,000.00
Matilda Goddard Legacy		500.00
Barthold Schlesinger "	2,000.00	2,000.00
Edward Austin Fund	365,034.09	366,549.09
Teachers' Fund	103,800.00	104,000.00
Letter Box Fund		10.50
Students' Deposits	200.00	450.00
Roentgen-Ray Experiment Fund		1,000.00
Sewage Experiment Fund		5,000.00
Walker Memorial Fund		26,558.97
Samuel Cabot Gift Brookine Land Account		20,000
M. I. T. Stock Account	845,856.48	841,620.64
	$3,456,099.46	$3,552,623.64
Increase, Consisting of:		
Bequests for Special Purposes, etc. (See page 4)	46,951.05	
Gifts and Bequests for General Purposes. (See page 4)	21,000.00	
Students' Deposits	250.00	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	5,000.00	
Net Gain on Stocks sold	1,656 30	
Walker Memorial Fund, net amount	26.558.97	102,416.32
Less Expenses more than Income		5,892.14
		$96,524.18

	102,416.32
	5,892.14
	$96,524.18

	,552,623.64
	841,620.64
	26,558.97
	5,000.00
	1,000.00
	450.00
	104,c..3.00
	10.50
	366,549.09
	2,000.00
	500.00
	1,000.00
	32,000.00
	40,600.00
	803,000.00
	100,000.00
	5,200.00
	25,000.00
	5,000.00
	12,956.63
	1,299.54
	37,378.78
	7,000.00
	314,349.28
	108,100.00
	686,850.21
	Sept. 30, 1902.

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Dividends, Bank Stocks	980.15
" " Scholarships	10,550.00	" State Tax returned on Bank Stocks	242.94
" " " James Savage Fund	400.00	" Bonds	64,906.45
" " Charlotte E. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,855.00
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,017.30
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	27,976.52		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	1,268.92		
" " Advances to Bond Premiums	4,622.25		
	$71,916.84		$71,916.84

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,838.00	Received Income from Railroad Bonds	11,663.00
Credited to Advances Bond Premiums	825.00		
	$11,663.00		$11,663.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	1,750.00	
Land and Building, Clarendon St., on account	2,750.00	
Use of Rooms and Gymnasium	1,044.12	
Cambridge Real Estate	438.68	$5,982.80

Department Supplies.

Chemistry	11,162.89	
Physics	6,903.07	
Mining	4,787.12	
Mechanical Engineering	2,730.17	
Civil Engineering	2,441.35	
Workshops	2,143.70	
Architecture	1,893.52	
Periodicals	1,770.26	
Applied Mechanics	1,399.48	
Geology	1,332.68	
Biology	1,020.87	
English	982.97	
Naval Architecture	750.87	
Mathematics	201.09	
Military	157.21	
Drawing	121.40	
Modern Languages	104.62	$39,903.27

Salaries.

Instruction	228,864.05	
Administration	32,796.04	
Labor	29,841.20	$291,501.29

General Expense.

Furniture		3,263.70	
Stationery and Office Supplies		2,642.04	
Postage		2,626.82	
Electrical Wiring, Lamps, etc.		1,330.89	
Sundries		1,226.90	
Express		1,115.50	
Janitor's Supplies		1,096.38	
Examinations		900.41	
Diplomas and Commissions		619.40	
Washing		599.35	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		86.25	
Engine Room Supplies:			
Oil	259.32		
Waste	68.84		
Sundries	62.40	390.56	
Library		317.45	
Ice		232.30	
Examination Books		217.07	
Graduation Exercises		174.20	
Removing Ashes		138.20	
Glass		137.77	
U. S. Vaults		75.00	
Gymnasium		71.59	$17,661.78

Repairs.

Department Improvements:			
Chemistry		3,890.03	
Mechanical Engineering		437.68	
Architecture		368.53	
Workshops		267.70	
Physics		266.09	
Mining		262.16	
Naval Architecture		150.54	
Geology		53.85	
Biology		47.61	
Civil Engineering		23.64	
English		3.76	
Applied Mechanics		1.25	5,772.84
Rogers Building			2,300.30
Walker "			1,648.39
Sundries			1,451.63
Steam Fitting			746.25
Engineering Building			580.47
Pierce Building			530.06
Boiler and Power House			277.62
Motor for fan for heating Huntington Hall			237.50
Gymnasium			103.70
			$13,648.76

BOSTON, November 14, 1902.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1902, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON, } *Members of the*
JAMES P. TOLMAN, } *Auditing Committee.*

BOSTON, November 14, 1902.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN, — I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1902.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1902, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.

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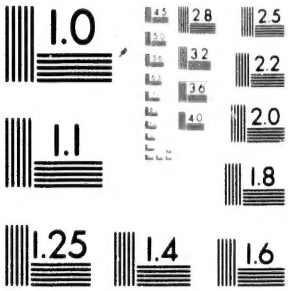

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